Transport analysis

Vehicle mileage on Swedish roads: an overview of estimation methods

Memorandum PM 2013:8

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Foreword

Vehicle mileage on the Swedish road network constitute basic statistical data used in various contexts, providing a basis for calculating and comparing a great deal of other statistical and investigational information.

Transport Analysis has recently received indications that the model used to estimate vehicle mileage is inconsistent with the breakdown of vehicle mileage by vehicle type. An internal developmental project has been initiated as a result. Its purpose is to review the existing methods used to estimate vehicle mileage on the Swedish road network and to ensure that the data sources used are of high quality.

This Memorandum Report contains both comparisons between different data sources and proposals for new methods for estimating vehicle mileage on the Swedish road network. Transport Analysis statistics for vehicle mileage on the Swedish road network will be updated in 2014, based on the proposed methods.

The work has been carried out by Project Manager Abboud Ado in collaboration with Anette Myhr, who also authored this Memorandum Report.

Stockholm, November 2013

Per-Åke Vikman
Department Manager

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Summary

Vehicle mileage by various vehicle types on the Swedish road network constitute basic statistical data used in various contexts. The model used to estimate vehicle mileage on Swedish roads has proven to have limitations, so Transport Analysis has reviewed calculation methods and relevant data sources.

Currently, the vehicle mileage on roads are estimated using a model based on the Swedish Transport Administration's measurements of traffic on the state owned road network. These data are adjusted using more-or-less static templates and broken down by vehicle type based on an estimated breakdown of the number of vehicles in use at the end of the year combined with estimated mileage for 2001–2003. The strength of the model lies in the fact that it is based on actual traffic measurements and includes all traffic at the measurement site, regardless of vehicle origin. Its most significant limitations stem from the facts that the traffic measurements are made only on state owned roads, that adjustments are made using old, uncertain template values, and that the vehicle type is determined with very low accuracy.

A new model for estimating the vehicle mileage on roads is presented here. The model is based on mileages for various vehicle types, calculated based on odometer readings from vehicle inspections. The data have been adjusted for the driving of Swedish vehicles abroad and of foreign vehicles on Swedish roads.

The new estimation model has been validated through comparisons with the Swedish Transport Administration's Road Traffic Barometer and average annual daily traffic (AADT) measurements and with data from Swedish and European road freight surveys.

Compared with the model used previously, the new model more accurately estimates the total vehicle mileage on Swedish roads and provides better knowledge of the shares accounted for by the various vehicle types.

1 Introduction

Vehicle mileage on the Swedish road network constitute basic statistical data used in various contexts. The measure provides a basis for calculating the negative direct effects of traffic, such as accidents, noise, emissions, and congestion. In Transport Analysis's own internal work, accurate insight into the magnitude and development of road traffic serves as a basis for comparing a great deal of statistical and investigational information.

We are seeking to measure vehicle mileage expressed in vehicle kilometres on Swedish roads for all vehicles. The vehicle mileage data will then also be broken down by, for example, vehicle type, road type, and region.

What is the best approach to doing this? No comprehensive measurements currently exist, but rather an attempt is made to estimate the vehicle mileage based on the data available.

The Swedish road network consists of state owned, regional, and private roads (Table 1.1). These roads are traversed by various sorts of vehicles, including passenger cars, lorries, buses, motorcycles, and mopeds, both Swedish and foreign.

Table 1.1. Length of the Swedish road network in kilometres, broken down by road type. Source: *Swedish Statistical Yearbook 2013*, Statistics Sweden.

Road types (including streets)	2012
Roads accessible by passenger car	579,412
Those open to public traffic	*215,296*
State owned roads	98,464
National core network	*8305*
Other national roads	*7080*
Regional roads	*83,079*
Municipal streets and roads	41,624
Private roads with state funding	75,208
Private roads without state funding	364,116

What sources are currently available for estimating vehicle miles travelled? Based on random traffic measurements, the Swedish Transport Administration calculates the vehicle mileage on the state owned road network every four years, measuring the changes monthly in the interim. This provides data covering the entire state owned road network, regardless of vehicle nationality.

The Swedish Institute for Transport and Communications Analysis (SIKA) has published vehicle-mile-travelled data for Swedish roads through 2010, based on the so-called VTI model. This model was developed by the Swedish National Road and Transport Research Institute (VTI) in the late 1990s and revised in 2007. It was based on data capturing changes in vehicle mileage on the state owned road network, which were then extrapolated to the entire Swedish road network using a constant factor. In other words, the model assumed that the vehicle mileage on the regional and private road network evolved the same as did the vehicle mileage on the state owned road network.

The vehicle mileage were further broken down by vehicle type, using shares calculated based on the breakdown of the vehicle fleet at the start and end of the year, which, given the large change in the number of vehicles on the road in summer months, yields an inaccurate picture of the breakdown of the vehicle mileage by vehicle type.

Odometer readings are recorded for passenger cars, lorries, buses, and motorcycles registered in Sweden when they are inspected. Using these inspection data, since 1999, Transport Analysis has been calculating annual mileages for all vehicles registered in Sweden. The vehicle mileage data could be used both to calibrate the estimation of vehicle mileage on the Swedish road network and to break down the vehicle mileage by vehicle type. However, it is unknown where the vehicles are being driven, i.e., in Sweden or abroad. Certain types of road traffic vehicles, such as mopeds and military vehicles, are absent from the register, although the four types that are included should account for the overwhelming majority of the vehicle miles travelled.

1.1 Purpose

The model used to estimate vehicle mileage on Swedish roads had its limitations, and Transport Analysis has recently received indications that the model is inaccurate with respect to the breakdown of the vehicle mileage by vehicle type.

To improve our estimates of vehicle mileage on Swedish roads, Transport Analysis has carried out a development project comprising the following steps:

- description and analysis of the existing estimation model
- identification of available data sources that could be used to improve the estimates
- quality assurance of data sources used
- proposals for a revised estimation model

Some of the data sources tested for use as bases include Transport Analysis's travel habits and road freight surveys, traffic accident statistics, and municipal road traffic measurements.

This report presents the results and conclusions of the entire development project.

2 Available data sources

2.1 The Mileage Database

One source used to calculate the vehicle mileage consists of odometer readings from vehicle inspections, which are used to estimate the annual mileages for passenger cars, lorries, buses, and motorcycles registered in Sweden. The odometer reading for each individual vehicle is recorded at each inspection. These data form a unique body of material, enabling us to know, for each inspected vehicle, just how far that vehicle has been driven over a given period of time, as well as technical data for the vehicle. The Transport Analysis database contains either an actual or an estimated mileage figure for every vehicle.

Description of estimation method

The odometer readings are used to estimate the vehicle mileage over one year for vehicles registered in Sweden. The population includes all passenger cars, lorries, buses, and motorcycles in the Swedish Vehicle Register in use at any time during the year in question. This means that even those vehicles that were deregistered during the year are included. Odometer readings have been saved for passenger cars, lorries, buses, and motorcycles from 1999 on.

The ability to calculate the mileage for a vehicle for a year requires that at least one inspection occur during the period from 1 January of the year in question through 31 January of the following year. The corresponding period for motorcycles is January 1 of the year in question through 15 August of the following year. Paired odometer readings are created using the inspection data. Each pair of odometer readings is formed by two consecutive measurement points, with the latter having to occur after 1 January of the year in question. A measurement point usually consists of a follow-up inspection, but it may also be the date of registration, with the odometer at zero. It is also possible for a vehicle to have multiple paired odometer readings during a given year, assuming that it has been inspected at least twice during that year. In cases in which no inspection has previously been performed, paired odometer readings can be formed by adding inspection 1 to the first registration date and setting odometer reading 1 to zero.

The absence of odometer readings for certain vehicles and the presence of unreasonable odometer settings that result in an inability to form an accurate pair of odometer readings constitute an uncertainty factor. A method for vetting the odometer readings for each individual vehicle is consequently needed.

This vetting method is based on using all the observed odometer readings for a vehicle. The registration number of a deregistered vehicle may be reused fairly quickly, but to prevent data belonging to another vehicle from remaining in the

database and affecting the results, the model includes a rule that an inspection date cannot occur more than 60 days before the registration date of a vehicle. This was not a problem when the model was new, but now we have to take 10 years of history into consideration.
In most cases we can determine whether the recorded odometer readings are reasonable in relation to one another. In those cases in which deviations are present, they may indicate an error. Such errors are divided into two groups: critical errors and other errors. Critical errors occur when the mileage between the two inspections is a negative number. These errors are due to power-of-ten errors, the odometer having turned over, or recording errors. Other errors are considerably more difficult to identify, and are attributable mainly to power-of-ten errors and recording errors. It is certainly the case that the corrections can be erroneous, and that incorrect odometer readings may sneak through, though the number of such errors should be insignificant. Despite attempted corrections, there are vehicles whose data are uncorrectable, making it more reasonable to estimate the mileages for these vehicles based on other sources. The model restricts the daily mileage for those vehicles that are corrected using the correction routines. The maximum average daily mileage is 600 km for passenger cars and light lorries and 800 km for heavy lorries and buses.

Based on the paired odometer readings, a daily mileage figure is calculated as the ratio between the number of kilometres driven between inspections divided by the number of days of vehicle use between inspections (see formula below).

Mileage per day = $\frac{M_2 - M_1}{D}$

M_1 = odometer reading at inspection 1
M_2 = odometer reading at inspection 2
D = number of days vehicle has been in use between the inspections

Days in use are estimated as the number of days between inspections less any days of not in use notified to the Swedish Transport Agency, in which ongoing periods of not in use must be taken into account, and not just those that have finished. A vehicle may undergo multiple inspections during a given year.

When calculating mileages using inspection data, consideration must be given to the number of days between different types of periods. The periods are defined as follows:

- **Period between two inspections:** When calculating the number of days in the period, the date of the first inspection, but not of the second inspection, must be considered part of the period.

- **Temporary deregistration period:** The vehicle must be considered temporarily deregistered as of and including the deregistration date and up to and including the day before the re-registration date.

- **Reference period:** To ensure that the number of days in the reference period is calculated in the same way for both the inspection and

deregistration periods, the end date for the reference period should not be included in the period. For example, to calculate the number of days in 2012, which is 366, the start date must be set at 1 January 2012 and the end date at 1 January 2013.

The daily mileage is then multiplied by the number of days the vehicle is in use during the year in question to derive the total mileage for the vehicle during the year.

Model estimates are made for vehicles that were not inspected during the reference year, and thus for which no valid odometer readings are available. Vehicles not inspected during the year in question can be divided into four groups: newly registered vehicles, directly imported vehicles, deregistered vehicles, and other vehicles. Three models are used for these vehicles: for new[1] and other vehicles, for directly imported vehicles, and for vehicles deregistered during the year.

Newly registered vehicles normally need not be inspected until three years after their registration date for passenger cars and light lorries, four years for motorcycles, and one year for heavy lorries and buses. As a result, several years may pass before an initial odometer reading enters the database.

“Other vehicles” include both those whose odometer readings are inaccurate and could not be corrected and those that, for one reason or another, were not inspected during the year in question. Because the inspection period for a vehicle extends over several months, it is not unusual to go more than 12 months between inspections.

The models used to estimate mileage are based on vehicles with approved mileages; it is assumed that vehicles that have not been inspected are, on average, driven as far per day as those that have been inspected.

When estimating mileages for vehicles that do not have valid paired odometer readings, one might suppose that the mileages for the vehicles that serve as the basis for the estimates follow a normal distribution. Such is not the case. Closer analysis of the data confirms that it is the logarithmized daily mileages that follow a normal distribution. As a basis for the analyses, vehicles with zero mileage have been excluded, as they cannot represent the vehicles in use during the year. Vehicles registered during the relevant reference year have been excluded, as it can be assumed that new vehicles that have also underwent an inspection are not representative. Vehicles that were not in use during the year have been assigned a mileage of zero.

Within each group, the vehicles are divided into smaller groups, so-called imputation groups, based on variables that affect their mileage. It is assumed in this process that the vehicle is driven the same distance each day it is in use during the period for which a vehicle-miles-travelled estimate is sought. The

[1] The definition of a new vehicle in year t is that the registration year $\geq t - 4$ and the (registration year – model year) < 3.

assumption that the vehicles are driven the same distance each day is probably relatively valid for passenger cars, lorries, and buses. On the other hand, motorcycles are used almost exclusively during the summer half of the year. As a result, when calculating mileages for motorcycles, it is assumed that the motorcycle was used April through September, i.e., no mileage is allocated during the winter half of the year, even if the motorcycle was registered as being in use. With respect to motorcycles, it is also true that their inspections usually occur during the summer, with the result that it is impossible to achieve the same level of quality for motorcycle mileages until later in the fall, which entails in turn that the reporting of the annual vehicle mileage by motorcycles exhibits a one-year time lag relative to those for passenger cars, lorries, and buses.

The total vehicle mileage are reported by adding the vehicle-by-vehicle mileages for each relevant reporting group. Because detailed data concerning the vehicle are retrieved from the Swedish Road Traffic Register, it is possible to report the total vehicle mileage broken down by, for example, model year and kerb weight.

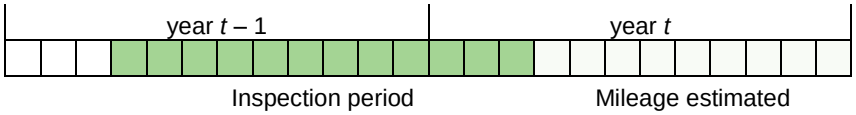
Uncertainty of the estimates

Odometer readings are used in a model that estimates, for a specific year, the vehicle mileage by the passenger cars, lorries, buses, and motorcycles registered in Sweden. Like all models, this model has its strengths and weaknesses.

Odometer readings are available only for passenger cars, lorries, buses, and motorcycles. Other vehicles, such as mopeds and tractors, are also driven on the roads of Sweden, though such vehicles should account for a miniscule share of the total traffic. It is not possible, using this model, to determine where the vehicles have been driven, which would mainly be of interest to local actors and in determining what share of the driving was done in Sweden versus outside of the country.

One weakness of the mileage calculations is that we calculate the vehicle mileage in a reference year (i.e., calendar year) based on mileages that fall in both the reference year and the year before (see example below).

Example



The vehicle above has two valid odometer readings, i.e., from an inspection in April of year *t* – 1 and from another inspection in April of year *t*. An average daily mileage is estimated for the period between the inspections. This daily mileage is then multiplied by the number of days in use during year *t* to obtain the annual mileage for *t*. This entails the implicit assumption that the same driving pattern prevails between the inspections as between the last inspection and the end of the year.

The vehicle mileage in a given year are thus reported as an average of the vehicle mileage in year *t* – 1 and year *t*. In the case of vehicles with two valid odometer readings, roughly half of the actual mileage will fall in year *t* – 1, and half in year *t*. New passenger cars are not inspected until after three years, which means that the mileage for year *t* depends on the driving pattern over several preceding years.

One consequence of this is that the vehicle mileage based on odometer readings constitute relatively simplistic material if we wish, for example, to examine the effects of economic conditions on passenger car usage. Another problem is that vehicles tend to be driven less the older they get (Figure 2.1), meaning that a degree of overestimation may be present in the reported material.

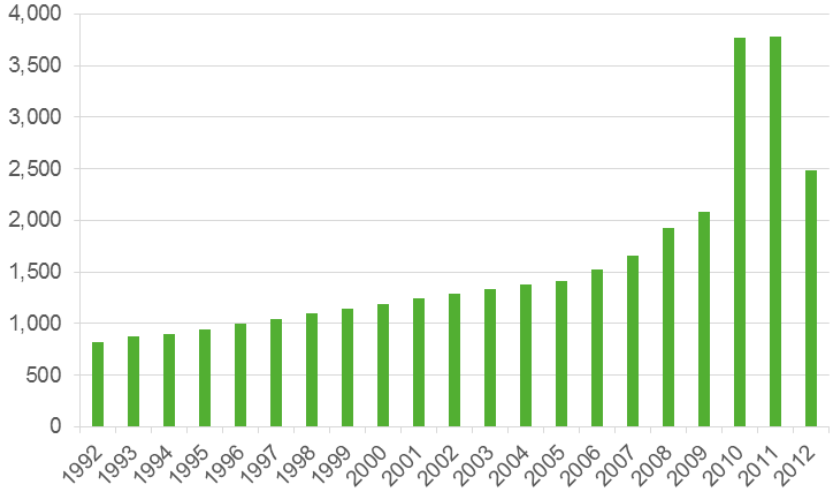


Figure 2.1. Average annual mileage (in 10s of kms) for passenger cars with unestimated mileage in 2012, broken down by model year.

The consequences of reporting the vehicle mileage so soon after the year in question, given the shift that this entails, include the fact that when major changes in vehicle mileage do occur, due mainly to economic fluctuations, there may be marked differences if we compare the results of this model with other sources for the specific year in question. In other words, the trends indicated by various models may in fact diverge for given individual years, one model possibly indicating an increase while another model indicates a decrease.

In addition to the aforementioned uncertainty, the mileages reported for a reference year are based on 20–50% estimated data (Table 2.1). This alone entails a degree of uncertainty in the data.

Table 2.1. Number of vehicles in 2012, the share of them that have an estimated mileage, and the number of vehicles not in use (2011 for motorcycles).

Vehicle type	No. of vehicles in use	No. of which are estimated	Share estimated	No. of vehicles not in use
Passenger cars	5,084,351	1,722,614	34%	726,137
Lorries	659,609	257,416	39%	155,261
Buses	17,655	3,594	20%	4,114
Motorcycles	336,439	157,706	47%	152,120

However, there is a point in reporting the data relatively soon after the end of the year in question (except for motorcycles, which are reported with a one-year time lag). We could wait for the actual figures, but the waiting period would be at least three years before all vehicles would have undergone their first inspection. Although conscious of the deficiencies of the model, Transport Analysis believes that the quality of the estimation model nevertheless suffices to make it possible to report mileages this soon after the end of the year, so that the data can also be used within a reasonable length of time.

Time series

The figures below indicate that passenger cars and motorcycles largely exhibit the same patterns and that the vehicle mileage have decreased since the economic weakness of 2008–2009, even though the number of vehicles in use has increased. It will be very exciting interesting to track the vehicle mileage by passenger cars in the future, as this measure has a major impact on emissions.

The effect of the most recent economic weakness is evident in the Development of the vehicle mileage by all vehicle types.

The fact that the vehicle mileage by light lorries increased concerns a corresponding increase in the number of light lorries.

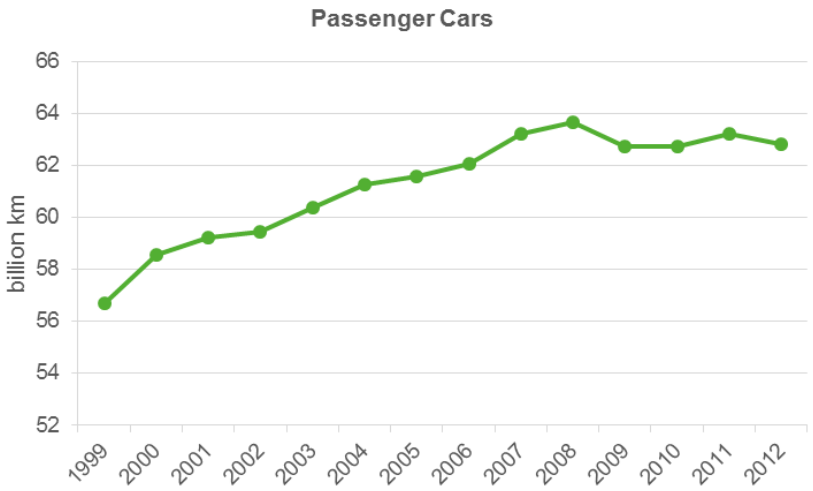


Figure 2.2. Annual mileage (in billions of kilometres) for passenger cars registered in Sweden, 1999–2012. Source: Mileage Database, Transport Analysis.

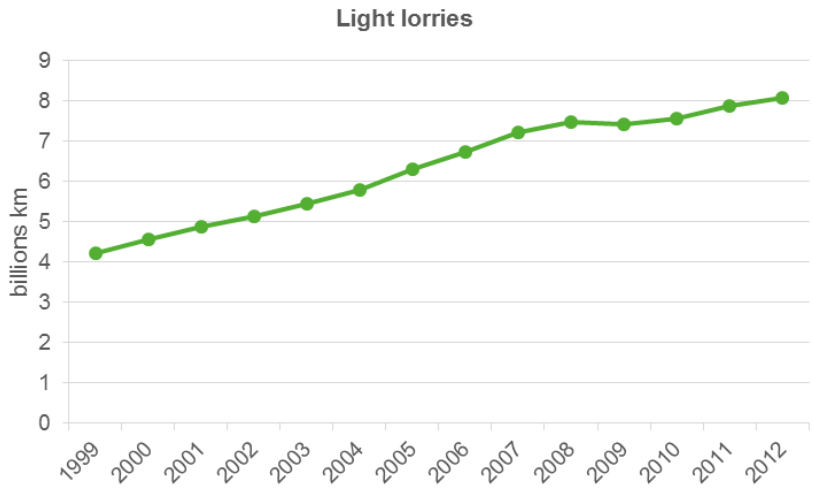


Figure 2.3. Annual mileage (in billions of kilometres) for light lorries registered in Sweden, 1999–-2012. Source: Mileage Database, Transport Analysis.

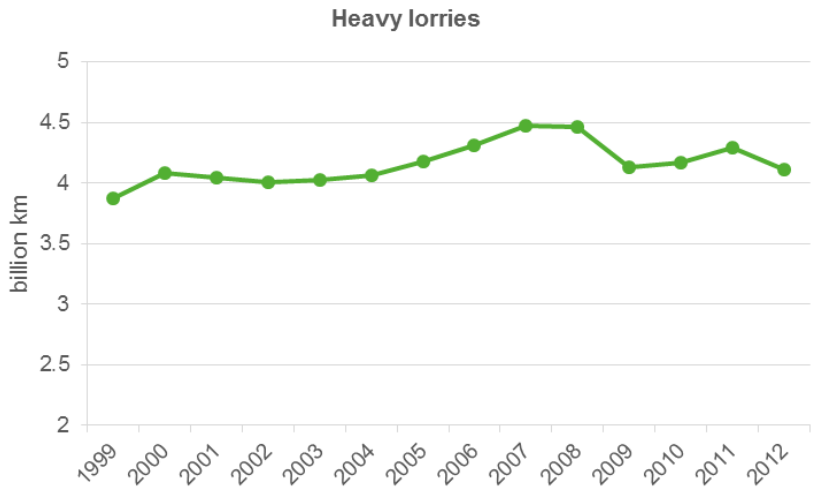


Figure 2.4. Annual mileage (in billions of kilometres) for heavy lorries registered in Sweden, 1999–2012. Source: Mileage Database, Transport Analysis.

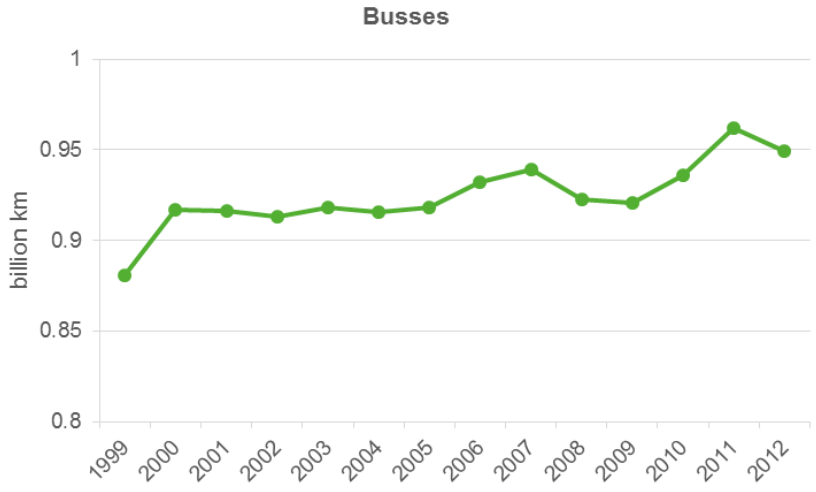


Figure 2.5. Annual mileage (in billions of kilometres) for buses registered in Sweden, 1999–2012. Source: Mileage Database, Transport Analysis.

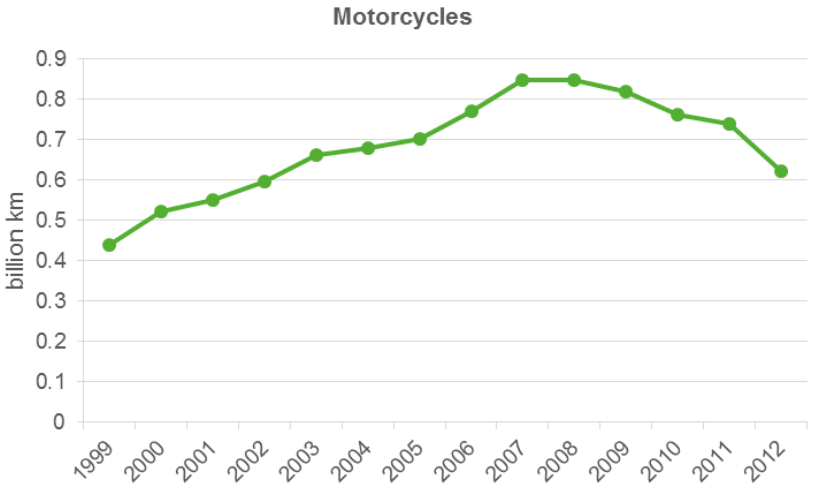


Figure 2.6. Annual mileage (in billions of kilometres) for motorcycles registered in Sweden, 1999–2011. Source: Mileage Database, Transport Analysis.

2.2 Traffic measurements

The Swedish Transport Administration began making ongoing measurements of the state owned road network in 1976 with a view to calculating a number of road traffic-related parameters associated with the state owned road network. These parameters are estimated using a system based on roughly 83 year-round measurement points spread over the entire state owned road network. These points are chosen at random, based on the criterion that they must be representative of a specific road network. Each measurement point represents a given share of the vehicle mileage on that road network.

In addition to the stationary measurements, the Swedish Transport Administration also makes measurements based on some 23,000 mobile stations, which are normally spread throughout the road network. After a four-year period readings from the mobile stations is considered to cover the entire state owned road network. The annual average daily traffic (AADT) for the road network is calculated using measurements from these mobile stations, broken down by road section.

The measurement method initially involved air hoses that registered passing axles, but a switch to inductive coils has been made in recent years, resulting in a change in the method used to identify vehicles in the measurements.

With hose measurements, the vehicles were sorted into 15 different classes, based on the number of axles and the distance between two axles. These vehicle classes were later aggregated into six vehicle classes, data on which were then stored in databases. Using inductive coils, the classification process is considerably less fine than when measuring using hoses. Inductive coils sort the vehicles into six different groups, based on vehicle length and mean amplitude. These classes are not comparable with the hose-based classes, but a

conversion is performed using template values[2] to enable comparability with the aggregated classes.

When the results are published, the classes are aggregated yet again into two classes, i.e., passenger cars and lorries, which should be interpreted with caution, as these classes are inconsistent with the definitions of passenger cars and lorries used by the Swedish Transport Agency. In addition to passenger cars and motorcycles, the Passenger Cars class also includes a large share of light lorries and a small but decreasing share of buses. In addition to heavy lorries, the Lorries class also includes buses and a significant share of light lorries. To avoid confusion, the terms “light vehicles” and “heavy vehicles” will be used henceforth rather than the traffic measurement classes “passenger cars” and “lorries”.

The Road Traffic Barometer

The Road Traffic Barometer that the Swedish Transport Administration publishes monthly contains estimates of the change in vehicle mileage based on the 83 stationary measurement points. One of the parameters reported in the Road Traffic Barometer is the mean value of the change in vehicle mileage over the last 12-month period compared with the 12-month period immediately prior. In addition to the total change in vehicle mileage by all vehicles, the change in the vehicle mileage by light and heavy vehicles is also reported, as shown in

Table 2.2.

Table 2.2. Change in vehicle mileage on the state owned road network, with 95% confidence intervals, for January–December 2012 compared with the preceding 12-month period. Source: Swedish Transport Administration.

Road category	Light vehicles	Heavy vehicles	Total
European highways	–0.3% ± 1.1	–0.5% ± 1.3	–0.3% ± 0.9
Other national roads	–0.9% ± 0.9	–0.1% ± 1.9	–0.8% ± 0.6
Primary regional roads	–1.0% ± 0.9	+1.0% ± 3.3	–0.7% ± 0.9
Other regional roads	–0.4% ± 1.5	–1.4% ± 3.3	–0.5% ± 1.6
Total change	–0.6% ± 0.6	–0.4% ±1.1	–0.6% ± 0.5

In the January edition of the Road Traffic Barometer, the 12-month period coincides with the calendar year, i.e., the change in vehicle mileage between January and December is compared with that between January to December of the preceding year. Table 2.3 shows the estimated changes in vehicle mileage according to the Road Traffic Barometer for 2000–2012 compared with the total for each preceding year on the state owned road network and for heavy and light vehicles.

[2] Forsman, G. (2012). Elucidation of the Swedish Transport Administration’s study of changes in vehicle miles travelled and method used to calculate index curves for the traffic flows.

Table 2.3. Change in vehicle mileage on the state owned road network compared with each preceding year, broken down by light vehicles, heavy vehicles, and total for all vehicles, 2000–2012.
Source: Swedish Transport Administration.

Year	Light vehicles	Heavy vehicles	Total
2000	0.013	0.038	0.015
2001	0.013	0.026	0.014
2002	0.034	0.024	0.033
2003	0.019	0.015	0.018
2004	0.009	0.017	0.010
2005	0,004	0.043	0.008
2006	–0.001	0.021	0.002
2007	0.024	0.053	0.028
2008	–0.009	0.000	–0.008
2009	0.010	–0.039	0.002
2010	–0.007	0.039	–0.002
2011	0.014	0.026	0.015
2012	–0.006	–0.004	–0.006

AADT

In addition to the Road Traffic Barometer, the Swedish Transport Administration also publishes vehicle milage data every four years for the state owned road network. These data are based on the annual average daily traffic (AADT) for the road sections into which the state owned road network is divided, and can be broken down by vehicle class, road category, road type, etc.

AADT data should be able to serve as an important source in validating the estimated change in vehicle mileage on the state owned road network obtained from the Road Traffic Barometer. There is, however, a defect that could lead to different degrees of underestimation for different years, and therefore to inaccurate estimation of the Development of the vehicle mileage between years: namely, the measurements for some sections of road were not made during the year in question but rather derive from earlier years, up to 15 years earlier in some cases. In calculating the vehicle mileage shown in Table 2.4, the Swedish Transport Administration made no projections for the prevailing situation in the current year for those road sections. European highways and national roads account for 80% of the vehicle mileage on the state owned road network, the traffic on which is measured during the current year or the year before for all years. These years can thus be compared with high certainty.

Table 2.4. Vehicle mileage on the state owned road network according to AADT measurements in 1000s of kilometres, broken down by light vehicles, heavy vehicles, and total for all vehicles, 2002, 2006, and 2011. Source: Swedish Transport Administration.

Year	Light vehicles	Heavy vehicles	Total
2002	44,438,887	5,093,220	49,532,107
2006	48,292,445	5,899,328	54,191,773
2011	50,525,676	6,614,135	57,139,811

It is worth noting that the vehicle mileage on the state owned road network per the AADT measurements are much higher for 2006 and 2011 than the vehicle mileage as calculated using existing methods based on the Road Traffic Barometer. The estimated values for 2002 are on almost the same level. Therefore, comparing the Development of the vehicle mileage on the state owned road network per the AADT measurements with the Development of the vehicle mileage on the state owned road network obtained via the Road Traffic Barometer (Figure 2.7) indicates that the Road Traffic Barometer tends to underestimate the number of vehicle mileage on the state owned road network. The biggest difference was generated between 2002 and 2006.

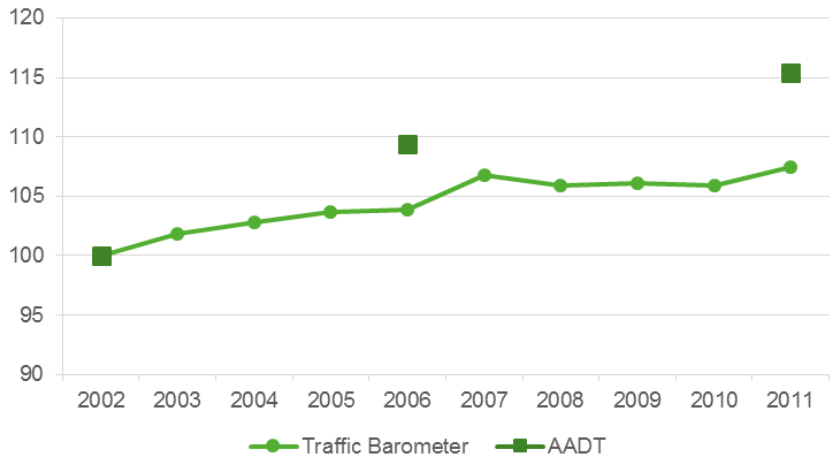


Figure 2.7. Development of vehicle mileage on state owned roads per the Road Traffic Barometer versus AADT measurements, 2002–2011. Index, 2002 = 100. Source: Swedish Transport Administration.

2.3 Comparison between traffic measurements and the Mileage Database

If we are to compare the development of vehicle mileage by various vehicle types as calculated using the traffic measurements included in the Mileage Database, the definitions of the vehicle types should be consistent. This can be ensured both by redistributing the vehicle types as per the Vehicle Register so that they are consistent with the definitions of light vehicles and heavy vehicles as per the traffic measurements, and by estimating, based on the traffic measurements, what shares of the vehicle mileage are generated by light and heavy vehicles, respectively.

Estimated breakdown by vehicle type

Using the change in total vehicle mileage and the change for each reported vehicle type, we can estimate the share of vehicle mileage that each vehicle type generated during the previous year.

Let Z_t, X_t, and Y_t designate the vehicle mileage in total, by light vehicles, and by heavy vehicles, respectively, during year *t*, which gives us:

$$Z_t = X_t + Y_t \quad (1)$$

In addition, let δz_{t+1}, δx_{t+1}, and δy_{t+1} designate the relative change in vehicle mileage in total, by light vehicles, and by heavy vehicles, respectively, between years (*t* + 1) and *t*. The total vehicle mileage during year *t* + 1 are derived from:

$$Z_{t+1} = Z_t * (1 + \delta z_{t+1}) = X_{t+1} + Y_{t+1} \quad (2)$$

$$X_{t+1} = X_t * (1 + \delta x_{t+1}) \quad (3)$$

$$Y_{t+1} = Y_t * (1 + \delta y_{t+1}) \quad (4)$$

The expressions in 1–4 give us:

$$Z_t * (1 + \delta z_{t+1}) = X_t * (1 + \delta x_{t+1}) + Y_t * (1 + \delta y_{t+1}),$$

which, by inserting 1, gives us:

$$Z_t * (1 + \delta z_{t+1}) = (Z_t - Y_t) * (1 + \delta x_{t+1}) + Y_t * (1 + \delta y_{t+1})$$

and furthermore

$$Z_t * (\delta z_{t+1} - \delta x_{t+1}) = Y_t * (\delta y_{t+1} - \delta x_{t+1}) \quad (5)$$

The share of vehicle mileage generated by heavy vehicles out of the total vehicle mileage in year *t* is then derived from the expression:

$$\frac{Y_t}{Z_t} = \frac{\delta z_{t+1} - \delta x_{t+1}}{\delta y_{t+1} - \delta x_{t+1}}$$

Table 2.5 shows the estimated shares of the vehicle mileage attributable to light and heavy vehicles, respectively, as calculated using the above expression. Unfortunately, the shares vary considerably between consecutive years, most certainly attributable to rounding errors in the change in vehicle miles travelled. This variation could be reduced considerably if the change in vehicle mileage per the Road Traffic Barometer were reported to one more decimal place.

Table 2.5. Estimated shares of vehicle mileage on the state owned road network for light vehicles and heavy vehicles calculated based on the change in vehicle mileage according to the Road Traffic Barometer, 1999–2010. Source: Swedish Transport Administration calculations.

Year	Light vehicles	Heavy vehicles
1999	0.920	0.080
2000	0.923	0.077
2001	0.900	0.100
2002	0.750	0.250
2003	0.875	0.125
2004	0.897	0.103
2005	0.864	0.136
2006	0.862	0.138
2007	0.889	0.111
2008	0.837	0.163
2009	0.891	0.109
2010	0.917	0.083

Another way of estimating the respective shares is to calculate the shares for a specific year and assume that they will remain valid when then successively calculating the shares for the remaining years, using the change in vehicle miles travelled.

Let the preceding assumption regarding the vehicle mileage and change in vehicle mileage apply, i.e., let Z_t, X_t, and Y_t designate the vehicle mileage in total, by light vehicles, and by heavy vehicles, respectively, in year *t*, and let δz_{t+1}, δx_{t+1}, and δy_{t+1} designate the relative change in vehicle mileage in total, by light vehicles, and by heavy vehicles, respectively, between years (*t* + 1) and *t*.

Furthermore, let βx_t and βy_t designate the shares of the total vehicle mileage during year *t* that are attributable to light and heavy vehicles, respectively. The following will then apply:

$$X_t = \beta x_t * Z_t$$

and

$$Y_t = \beta y_t * Z_t$$

which, in combination with expressions 2–4, give us the share of vehicle mileage by lorries during year *t* + 1, i.e., βy_{t+1}, from the following:

$$\frac{Y_{t+1}}{Z_{t+1}} = \frac{(1 + \delta y_{t+1}) * \beta y_t * Z_t}{(1 + \delta z_{t+1}) * Z_t} = \beta y_t * \frac{1 + \delta y_{t+1}}{1 + \delta z_{t+1}}$$

Correspondingly, we derive βy_{t-1} from the following:

$$\frac{Y_{t-1}}{Z_{t-1}} = \frac{\frac{\beta y_t * Z_t}{1 + \delta y_t}}{\frac{Z_t}{1 + \delta z_t}} = \beta y_t * \frac{1 + \delta z_t}{1 + \delta y_t}$$

The challenge here is to determine which yearly shares reflect reality, as the shares vary from year to year. If we choose a year that has an overestimated share of vehicle mileage by heavy vehicles, all other years will have overestimated values. Correspondingly, we will obtain underestimated values if we choose a year when the heavy vehicle share has been severely underestimated.

One way of circumventing this problem is to compare the shares from the Road Traffic Barometer with those derived from the AADT measurements. The problem with the AADT measurements is that the underlying data are not projected to the reference year, which can underestimate the share of vehicle mileage attributable to heavy vehicles. On the other hand, we will overestimate this share if we filter out road sections with old measurements, resulting in the overrepresentation of European highways and national roads, which typically exhibit higher shares of vehicle mileage attributable to heavy vehicles.

Table 2.6. Heavy vehicle share of vehicle mileage by road category and total for the entire state owned road network per AADT measurements, 2002 and 2006. Source: Swedish Transport Administration.

Road category	All measurements 2002	Measured during year, 2002	All measurements 2006	Measured during year, 2006
European highways	0.127	0.126	0.130	0.133
National roads	0.113	0.112	0.122	0.123
Primary regional roads	0.085	0.072	0.092	0.072
Secondary regional roads	0.062	0.056	0.066	0.100
Tertiary regional roads	0.060	0.068	0.062	0.075
Secondary/tertiary regional roads	0.054	0.081	0.056	0.078
Data lacking	0.075	0.058	0.123	0.141
The state owned road network	0.105	0.119	0.109	0.128

If we now instead determine the average shares after having calculated them by assuming that the shares for each year between 1999 and 2011 are accurate (we exclude the shares for 2002, as they appear to include a very high vehicle-miles-travelled share for heavy vehicles), we derive the shares shown in

Table **2.7**, which, for 2002 and 2006, fall within the range of the overestimated and underestimated shares we obtained from the AADT measurements.

Table 2.7. Average shares of vehicle mileage on the state owned road network by light and heavy vehicles, calculated based on the change in vehicle miles travelled, 1999–2011. Source: Swedish Transport Administration and calculations by Transport Analysis.

Year	Light vehicles	Heavy vehicles
1999	0.895	0.105
2000	0.893	0.107
2001	0.892	0.108
2002	0.893	0.107
2003	0.893	0.107
2004	0.892	0.108
2005	0.889	0.111
2006	0.886	0.114
2007	0.884	0.116
2008	0.883	0.117
2009	0.888	0.112
2010	0.883	0.117
2011	0.882	0.118

Redistribution of the vehicle types in the Mileage Database

To enable comparison between the mileages of vehicles registered in Sweden and changes in the vehicle mileage per the Road Traffic Barometer, we first redefine the vehicle types in the Mileage Database so that they are consistent with the light and heavy vehicles reported in the Road Traffic Barometer. We do this by considering all vehicles with the following properties to be heavy vehicles:

- three or more axles
- two axles with an axle spacing greater than or equal to 3.3 metres

The remaining vehicles, i.e., vehicles with two axles in which the axle spacing is less than 3.3 metres, are considered light vehicles.

Table 2.8 shows mileages for light and heavy vehicles following the redistribution as per the traffic measurement definitions for 1999–2011, plus the share of total mileage for each vehicle class. Light vehicles, which include all passenger cars and motorcycles, a large share of light lorries, and a very small share of buses and heavy lorries, accounted for just over 91% of the total vehicle mileage by vehicles registered in Sweden. Heavy vehicles, which include nearly all heavy lorries and buses plus a large share of light lorries, accounted for 8–9% of the vehicle miles travelled.

Table 2.8. Annual mileage (in billions of kilometres) for vehicles registered in Sweden per the Mileage Database, broken down by light vehicles (Lv), heavy vehicles (Hv), and total for all vehicles, 1999–2011. Source: Transport Analysis.

Year	Lv	Hv	Total	Share for Lv	Share for Hv
1999	60.70	5.42	66.12	0.918	0.082
2000	62.86	5.78	68.65	0.916	0.084
2001	63.72	5.88	69.61	0.915	0.085
2002	64.16	5.94	70.10	0.915	0.085
2003	65.38	6.05	71.42	0.915	0.085
2004	66.51	6.20	72.71	0.915	0.085
2005	67.23	6.46	73.69	0.912	0.088
2006	68.09	6.73	74.83	0.910	0.090
2007	69.61	7.06	76.68	0.908	0.092
2008	70.24	7.16	77.39	0.908	0.092
2009	69.16	6.85	76.00	0.910	0.090
2010	69.16	6.98	76.14	0.908	0.092
2011	69.86	7.32	77.18	0.905	0.095

Compared with the shares for heavy vehicles calculated using the change in Road Traffic Barometer data (

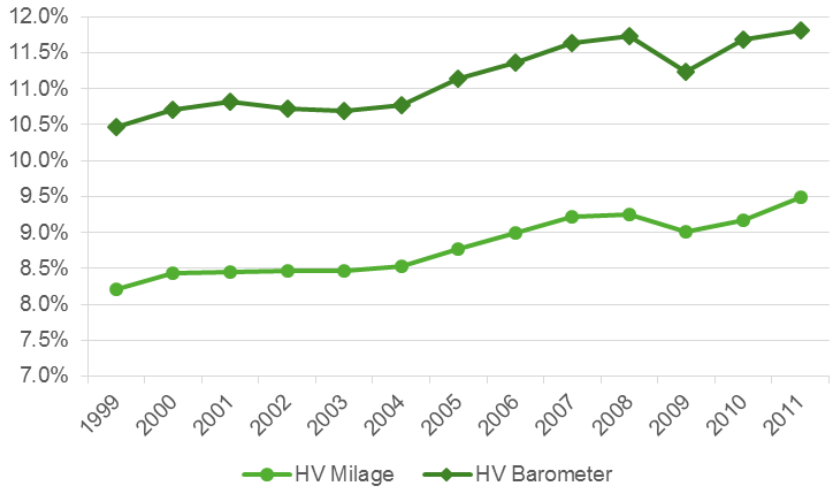


Figure 2.8), the shares from both sources track one another very closely. The fact that the shares do not agree with one another is natural, and can be explained by the facts that heavy vehicles are driven more extensively on the state owned road network than on the rest of the roads, and that the mileage figures do not include the mileage for foreign vehicles, which are driven mostly on the state owned road network.

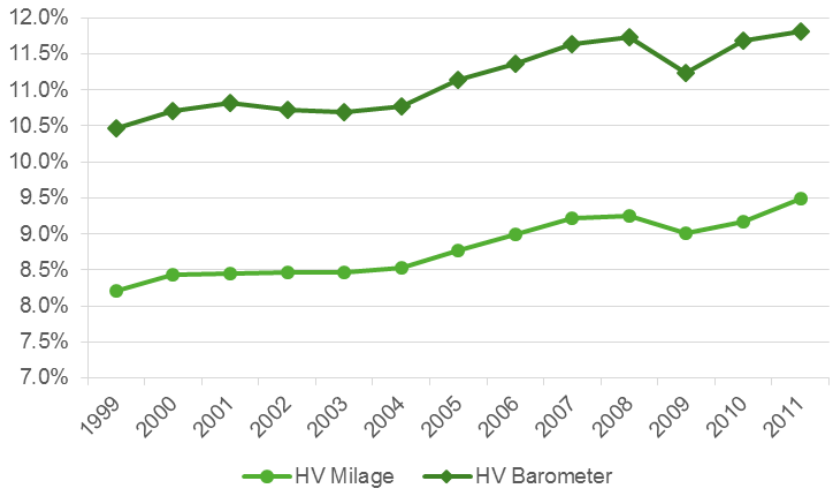


Figure 2.8. Heavy vehicle share of vehicle mileage on the state owned road network per the Road Traffic Barometer versus heavy vehicle share of the total mileage for vehicles registered in Sweden according to the Mileage Database, 1999–2011. Source: Swedish Transport Administration and Transport Analysis.

With respect to the change in vehicle miles travelled, Figure 2.9 shows that the change in vehicle mileage by heavy vehicles on the state owned road network according to the Road Traffic Barometer tracks the changes in mileage for heavy vehicles quite closely. There are major differences in some years, partly explainable by the representation of foreign heavy vehicles on the state owned road network but not in the Mileage Database, by the inclusion in the mileage figures of mileage driven abroad, and by the uncertainty of the estimates. Another cause of differences in the change value could be that the estimation error from one of the sources is very large during the years when the difference is great.

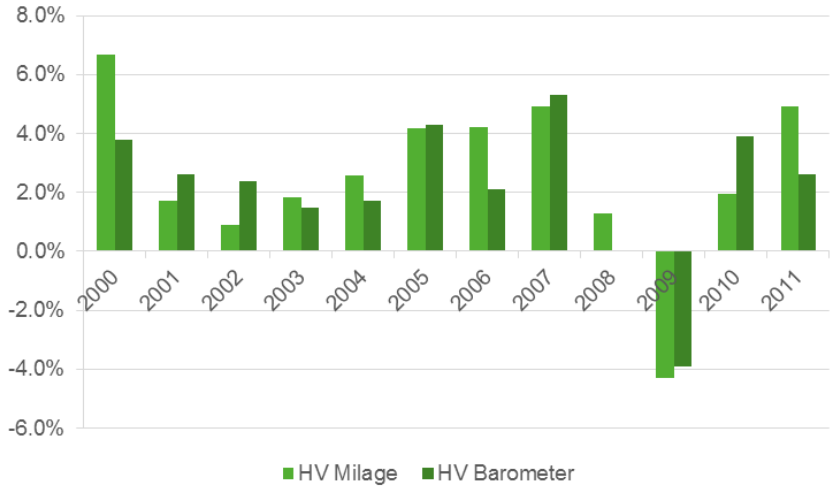


Figure 2.9. Change from the previous year in vehicle mileage for mileages of heavy vehicles registered in Sweden and for heavy vehicles' vehicle mileage on the state owned

road network, 2000–2011. Source: Transport Analysis and Swedish Transport Administration.

Conversely, if we look at the development of vehicle mileage by heavy vehicles on the state owned road network since 1999 according to the Road Traffic Barometer estimates (Figure 2.10), we see that it largely tracks the development of the mileage for heavy vehicles registered in Sweden according to the Mileage Database estimates. Because the Road Traffic Barometer also estimates the vehicle mileage by foreign vehicles, which drive almost exclusively on the state owned road network, and because Swedish vehicles have, over the years, been driven abroad to a lesser extent than foreign vehicles have been driven in Sweden (according to the road freight survey), the growth in vehicle mileage by heavy vehicles according to the Road Traffic Barometer should be greater than the growth in mileage for heavy vehicles registered in Sweden. That such is not the case could indicate that the Road Traffic Barometer underestimates the change in vehicle mileage on the state owned road network, which also proved to be the case when we compared the Road Traffic Barometer and AADT measurements.

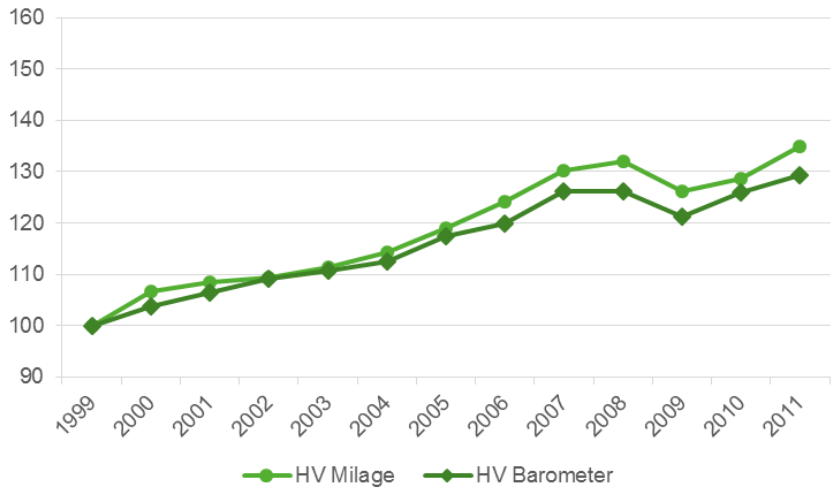


Figure 2.10. Growth of vehicle mileage by heavy vehicles on the state owned road network according to the Road Traffic Barometer versus the growth of mileage figures for heavy vehicles registered in Sweden, 1999–2011. Index, 1999 = 100. Source: Transport Analysis and Swedish Transport Administration.

With regard to light vehicles, Figure 2.9 shows a major difference in the change in vehicle mileage on the state owned road network compared with the change in mileage figures for light vehicles registered in Sweden. In addition to major differences in the change in vehicle mileage in 2000, 2002, and 2006, there are also major differences in the years of the financial crisis, which could be attributable to the shift in estimates in the Mileage Database.

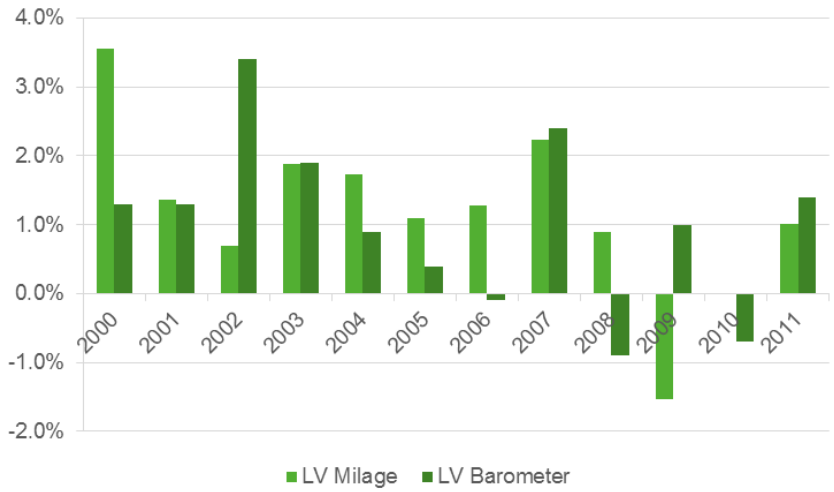


Figure 2.9. Change from previous year in vehicle mileage for light vehicles on the state owned road network versus change from the previous year in mileage for light vehicles registered in Sweden, 2000–2011. Source: Transport Analysis and Swedish Transport Administration.

Despite these differences, the development of the vehicle mileage by light vehicles on the state owned road network since 1999 compared with the development of the mileage for vehicles registered in Sweden indicates that, independent of one another, both sources estimate the vehicle mileage in a satisfactory manner (

Figure 2.**10**).

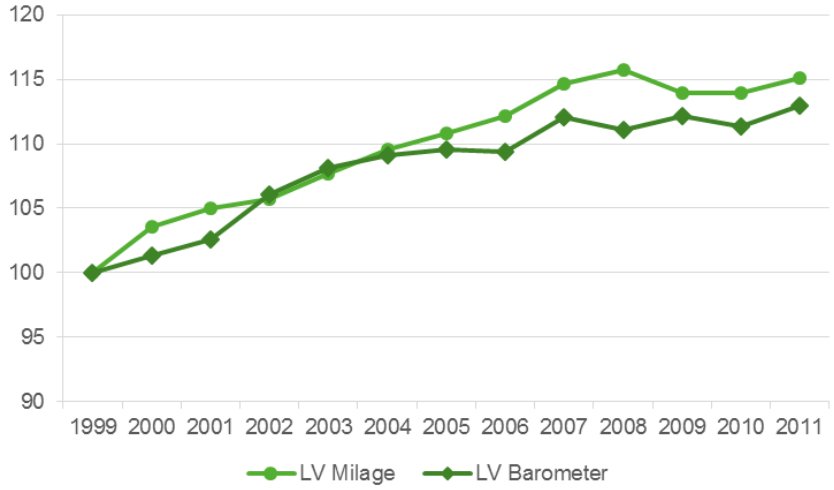


Figure 2.10. Development of vehicle mileage by light vehicles on the state owned road network according to the Road Traffic Barometer versus development of mileage figures for light vehicles registered in Sweden, 1999–2011. Index, 1999 = 100. Source: Transport Analysis and Swedish Transport Administration.

Adjustment of mileages

As noted above, the Mileage Database covers all vehicle mileage by vehicles registered in Sweden, regardless of whether they were driven on Swedish roads or abroad, and offers no means of breaking them down. To calculate the vehicle mileage on Swedish roads by vehicles registered in Sweden and by vehicles registered abroad, we will need to estimate the following:

- the share of the total vehicle mileage by Swedish vehicles attributable to vehicle mileage by those vehicles abroad
- the share of the total vehicle mileage in Sweden by all vehicles attributable to foreign vehicles

We assume in the case of buses, motorcycles, and light lorries that foreign vehicles are driven to the same extent in Sweden as Swedish vehicles are driven abroad. This assumption is made partly because there are no reliable sources for estimating the vehicle mileage by foreign vehicles in Sweden and partly because the mileage driven by Swedish vehicles abroad is very small as a share of total vehicle mileage and hence has only a marginal impact on it.

Heavy lorries

The Swedish road freight survey, a continuous sample survey conducted quarterly with a view to estimating goods shipments via Swedish heavy lorries with maximum load weights above 3.5 tonnes, can be used to estimate the vehicle mileage by Swedish heavy lorries. Table 2.9 shows the mileage in thousands of kilometres for heavy lorries registered in Sweden from 2000 to 2011, broken down by domestic shipments, shipments from Sweden to foreign countries, shipments from foreign countries to Sweden, cabotage, and third-country traffic.

The mileage for the domestic shipments is from driving entirely within Sweden while the mileage for cabotage and third-country traffic is from driving exclusively outside Sweden. In the case of shipments from Sweden to foreign countries and vice versa, some of the mileage is driven in Sweden. Though the mileage driven in Sweden for these shipments has not been calculated at the micro level, based on analyses of departure points and destinations, roughly 30% of the mileage for these shipments was likely driven in Sweden.[3]

Table 2.9. Mileage driven (in millions of kilometres) by heavy lorries registered in Sweden according to the road freight survey, broken down by domestic shipments, shipments from Sweden to foreign countries, shipments from foreign countries to Sweden, cabotage, and third-country traffic, 2000–2011. Source: Transport Analysis.

Year	Total	Domestic	From Sweden to foreign countries	From foreign countries to Sweden	Cabotage and third-country traffic
2000	2,565	2,270	125	125	45

[3] Transport Analysis's own analysis of micro data from the road freight survey.

2001	2,529	2,231	120	129	50
2002	2,595	2,257	144	132	61
2003	2,547	2,190	142	142	73
2004	2,528	2,227	123	122	55
2005	2,683	2,405	114	107	57
2006	2,704	2,396	127	123	58
2007	2,827	2,522	128	124	54
2008	2,930	2,605	134	126	65
2009	2,647	2,426	88	85	43
2010	2,738	2,486	105	102	46
2011	2,669	2,419	103	105	42

Estimating the mileage driven in Sweden originating from shipments from Sweden to foreign countries and vice versa enables us to redistribute the total mileage for Swedish heavy lorries according to mileage driven within Sweden and abroad, and to calculate the share of the total mileage for these shipments that is driven abroad (Table 2.10). The share of the vehicle mileage that is driven abroad for shipments involving heavy lorries decreased somewhat, from 8.6% to 7.0%, during the period from 2000 to 2011.

Table 2.10. Mileage driven (in millions of kilometres) by heavy lorries registered in Sweden according to the road freight survey, broken down by mileage in Sweden and mileage abroad, plus the share of the total mileage driven abroad, 2000–2011. Source: Transport Analysis.

Year	Total	Within Sweden	Outside Sweden	Share outside Sweden
2000	2,565	2,345	220	0.086
2001	2,529	2,305	224	0.088
2002	2,595	2,340	255	0.098
2003	2,547	2,276	272	0.107
2004	2,528	2,301	227	0.090
2005	2,683	2,472	212	0.079
2006	2,704	2,471	233	0.086
2007	2,827	2,598	230	0.081
2008	2,930	2,683	247	0.084
2009	2,642	2,478	164	0.062
2010	2,738	2,548	191	0.070
2011	2,669	2,481	188	0.070

To adjust the mileage for heavy vehicles estimated based on the Mileage Database, we should be able to subtract the mileage driven outside of Sweden according to the road freight survey. However, compared with the mileage from the Mileage Database, the road freight survey underestimates the mileage for corresponding vehicles that fall within the scope of the road freight survey.

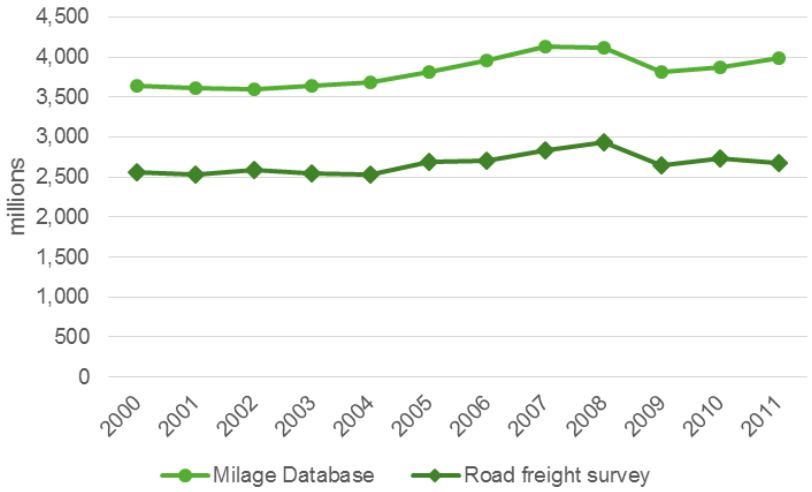


Figure 2.**11** shows that this underestimation remains fairly constant at a level of roughly 30% over the years. Part of this underestimation is logical, as the road freight survey focuses on goods shipments with associated empty runs, omitting mileage of other kinds. This underestimation does not affect the results presented here, as these shipments occur exclusively within Sweden. However, this does not explain the major underestimation that is present, which is due partly to the over-reporting of downtime for the lorries included in the survey sample and partly to the assumption that the dropout in the survey is random.

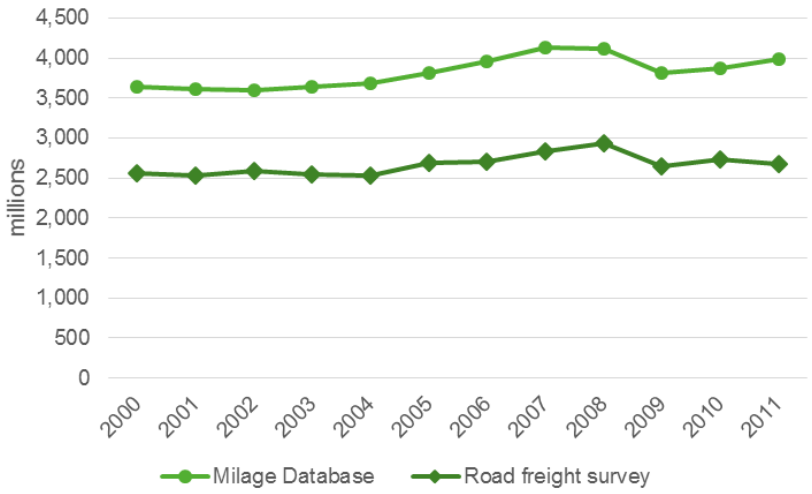


Figure 2.11. Estimated annual mileage (in millions of kilometres) for heavy lorries registered in Sweden according to the road freight survey versus annual mileage for the same lorries according to the Mileage Database, 2000–2011. Source: Transport Analysis.

If the degree of underestimation is the same for shipments inside and outside of Sweden, it should be possible to use the calculated share of the total mileage for heavy lorries accounted for by mileage driven abroad and multiply it by the mileage for corresponding lorries obtained from the Mileage Database to obtain the mileage driven abroad by these vehicles.

In 2012, Transport Analysis conducted extra quarterly surveys to estimate the underestimation generated by the over-reporting of downtime.[4] With respect to the mileage driven, the total underestimation of all mileage was 19.3%. The underestimation was 19.7% for the domestic shipments and 15.3% for the shipments abroad. This means that, to estimate the true shares of the mileage driven abroad by these vehicles, we need to adjust the domestic traffic upward by a factor of 1.245 and the traffic abroad upward by a factor of 1.181.

Table 2.8 shows the mileages according to the road freight survey after the foregoing adjustments, along with the share of the total mileage accounted for by mileage driven abroad by corresponding lorries per the Mileage Database. To calculate the mileage driven in Sweden by these vehicles, it should be possible to subtract the mileage abroad from the total mileage for the vehicles per the Mileage Database, or to use the latter-mentioned share.

[4] Transport Analysis Report 2013:12. Swedish national and international road goods transport 2012.

Table 2.8. Estimated annual mileage (in millions of kilometres) for heavy lorries registered in Sweden according to the road freight survey, after adjusting for over-reported downtime, 2000–2011. Source: Transport Analysis.

Year	Road freight survey	0utside Sweden	Share of Road freight survey	Share of Mileage database
2000	3,175	260	0.082	0.071
2001	3,130	264	0.084	0.073
2002	3,209	301	0.094	0.084
2003	3,148	321	0.102	0.088
2004	3,128	268	0.086	0.073
2005	3,323	250	0.075	0.065
2006	3,347	275	0.082	0.070
2007	3,500	271	0.078	0.066
2008	3,627	292	0.080	0.071
2009	3,275	194	0.059	0.051
2010	3,393	225	0.066	0.058
2011	3,307	222	0.067	0.056

In addition to the mileage driven abroad by lorries registered in Sweden, we also need to estimate the mileage driven in Sweden by foreign lorries. This can be done using corresponding road freight surveys, which are conducted by all EU countries and are currently available at an aggregated level for 2004–2010.[5]

Information is available from Eurostat on shipments from Sweden to foreign countries and vice versa, cabotage carried out in Sweden, and the number of transit runs in Sweden. The cabotage shipments occur entirely on Swedish soil. Using a distance matrix at the NUTS2 level, which Statistics Sweden created for Transport Analysis, the mileage in Sweden can be calculated for shipments from foreign countries to Sweden and vice versa. With respect to transit runs, such runs are made mainly between Finland, Norway, and the continent, with the result that an average of 4,450 km is driven through Sweden for each transit run. The results of the processing are presented in Table 2.9.

[5] Transport Analysis Report 2012:3. Foreign lorry shipments in Sweden, 2009–2010.

Table 2.9. Estimated annual mileage (in millions of kilometres) driven in Sweden by foreign heavy lorries, broken down by shipments from Sweden to foreign countries, shipments from foreign countries to Sweden, cabotage, and transit shipments through Sweden, 2004–2010. Source: Eurostat, with processing by Transport Analysis.

Year	From Sweden to foreign countries	From foreign countries to Sweden	Cabotage	Transit	Total inside Sweden
2004	194	202	65	100	561
2005	201	205	76	119	600
2006	222	231	85	78	617
2007	237	243	101	82	663
2008	252	260	123	79	714
2009	225	217	105	81	628
2010	244	252	131	87	715

The share of total vehicle mileage on Swedish roads attributable to foreign heavy lorries rose from 14% in 2004 to 16% in 2010 (Figure 2.14). The ratio between the mileage driven by foreign lorries in Sweden and the mileage driven by Swedish lorries abroad rose from 2.09 times in 2004 to 3.18 times in 2010.

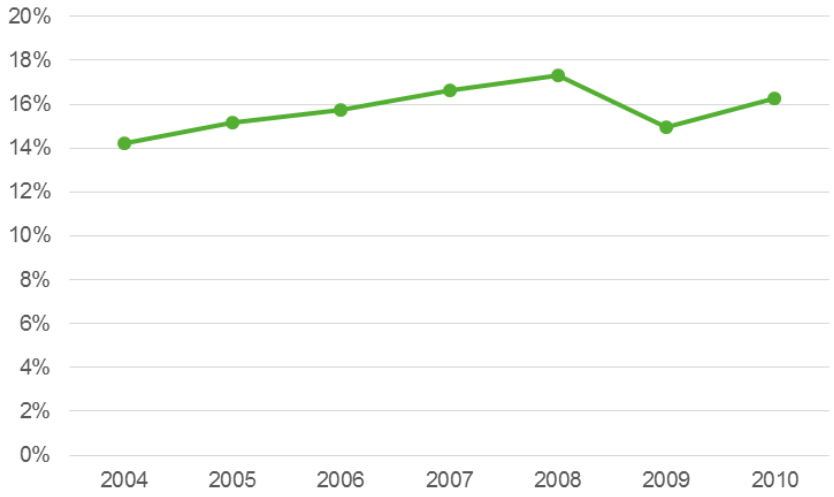


Figure 2.14. The share of total vehicle mileage on Swedish roads by heavy vehicles accounted for by vehicle mileage on Swedish roads by foreign heavy lorries, 2004–2010. Source: Transport Analysis and Eurostat.

Because the values derive from sample surveys conducted in the same way as the survey in Sweden, there is a risk that these surveys will also underestimate the vehicle miles travelled. However, because no known studies from these countries indicate that the figures are underestimated, we have chosen to use the existing estimates to adjust for the vehicle mileage on Swedish roads by

foreign lorries. However, we do need to estimate the values for the years before 2004, and for 2011 and 2012.

In addition to the value for 2005, which may contain erroneous estimates, the vehicle mileage generated by transit runs through Sweden remain constant over the years. We have consequently chosen to use the average number of transit runs per year from 2004 and 2006–2010 to estimate the transit runs for the years for which information regarding transit runs by foreign lorries is lacking.

With respect to the vehicle mileage for shipments to and from Sweden and for cabotage shipments, comparison of the total vehicle mileage in Sweden for these shipments versus foreign trade data between Sweden and the EU27 countries indicates a very strong correlation (

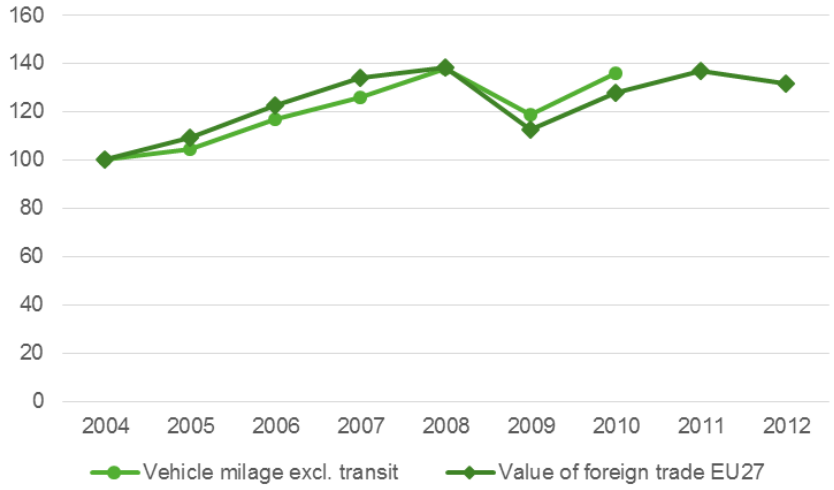


Figure 2.12).

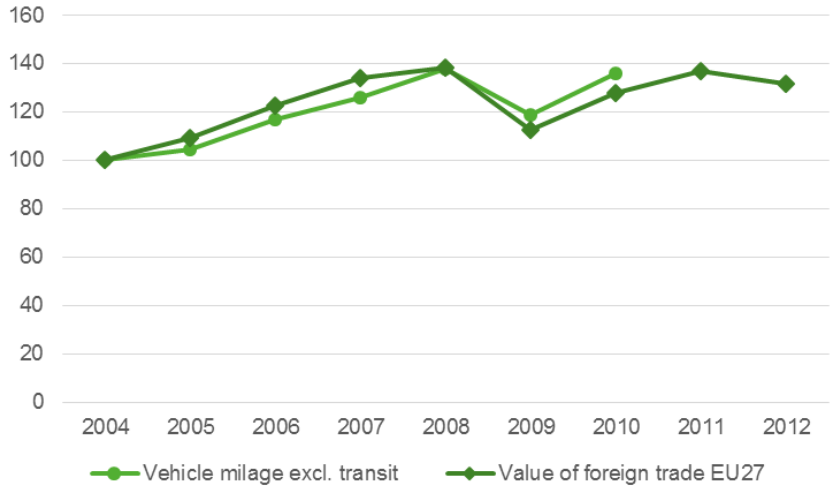


Figure 2.12. The development of vehicle mileage by foreign heavy lorries on Swedish roads and the value of foreign trade between Sweden and the EU 27 countries, 2004–2012. Index, 2004 = 100. Source: Transport Analysis and Statistics Sweden.

To estimate the vehicle mileage in Sweden by foreign heavy lorries in the years before 2004 and in 2011 and 2012, we should be able to adapt a linear regression line based on the known values for 2004–2010, but because the ratio between the vehicle mileage and the value of foreign trade has increased over the years, there is a risk of underestimating the vehicle mileage in the later years. Accordingly, we choose instead to calculate the average ratio for 2004–2010; multiplying this by the value of foreign trade for the unknown years yields estimates of the vehicle mileage in Sweden by foreign heavy lorries for those years. Table 2.10 shows the estimated vehicle mileage in Sweden by foreign lorries and the estimated vehicle mileage abroad by Swedish lorries, plus the ratios between those estimates, for 1999–2011. Subtracting the vehicle mileage by Swedish heavy lorries abroad from the mileages for heavy vehicles and then adding the vehicle mileage by foreign heavy lorries in Sweden yields adjusted mileages that estimate the vehicle mileage on Swedish roads for all heavy vehicles.

Table 2.10. Estimated vehicle mileage (in millions of kilometres) in Sweden by foreign heavy lorries, estimated vehicle mileage abroad by Swedish heavy lorries, and the ratios between those estimates, 1999–2010. Source: Transport Analysis and Eurostat.

Year	Vehicle mileage by foreign vehicles in Sweden	Vehicle mileage by Swedish vehicles abroad	Ratio
1999	449	244	1.84
2000	491	260	1.89
2001	484	264	1.83
2002	486	301	1.62
2003	503	321	1.57
2004	561	268	2.09
2005	600	250	2.40
2006	617	275	2.24
2007	663	271	2.44
2008	714	292	2.45
2009	628	194	3.24
2010	715	225	3.18
2011	711	222	3.20

Passenger cars

Adjusting the mileage for passenger cars so that the mileage driven by Swedish passenger cars abroad is subtracted and the mileage driven in Sweden by foreign passenger cars is added is not without its problems. We lack relevant information about the foreign passenger cars, and our information about the mileage driven by the Swedish passenger cars abroad is uncertain.

Data from travel habit surveys indicate that the share of the total passenger car mileage for Swedish drivers accounted for by passenger cars driven on trips

abroad between 1999 and 2011 rose from 1.5% to 2.5%. The shares are lower if we exclude the mileage driven in Sweden in connection with trips made abroad. A significant portion of trips made abroad involving passenger cars consists of commutes, which means that the share of the mileage in Sweden should be higher than the estimated share for domestic shipments involving heavy lorries, which is estimated at 30%.

With regard to the vehicle mileage in Sweden by foreign passenger cars, earlier reports based on the involvement of such vehicles in personal injury accidents have estimated that they account for 1.5% of the total passenger car vehicle mileage in Sweden.[6] However, there are questions regarding the use of road traffic injuries in estimating vehicle mileage by foreign vehicles in Sweden. In the case of heavy lorries, it has been shown that the share of the total vehicle mileage in Sweden accounted for by vehicle mileage by foreign heavy lorries is much higher than the share of foreign heavy lorries involved in traffic accidents in Sweden. If this is true of passenger cars as well, then the vehicle mileage in Sweden by foreign passenger cars is being underestimated.

In light of the preceding, and because the differences between the vehicle mileage by foreign passenger cars in Sweden and the vehicle mileage by Swedish vehicles abroad are not great, we choose not to adjust the mileage for passenger cars until we have reliable sources for estimating the vehicle mileage by these vehicles.

Results

Comparisons between mileages for heavy vehicles according to the Road Traffic Barometer and according to AADT measurements indicate that the two series of adjusted mileages for heavy vehicles follow the exact same development in terms of vehicle mileage on the state owned road network.

Although the development of the vehicle mileage on the state owned road network according to the Road Traffic Barometer does not follow the same pattern as do the adjusted mileages or the AADT measurements, the differences are very small. The estimated mileages for heavy lorries based on the Road Traffic Barometer alone should consequently be reliable.

Furthermore, comparison as of 2006 indicates that the vehicle mileage by heavy vehicles on the state owned road network according to the Road Traffic Barometer have evolved in the same way as have those estimated using the AADT measurements and as have the adjusted mileages.

With regard to light vehicles, which account for most of the vehicle mileage on Swedish roads regardless of the road network, the differences in terms of the development of the vehicle mileage according to the different sources are greater. Since 2002, the vehicle mileage by light vehicles on the state owned system according to AADT measurements have exhibited a steeper

[6] VTI Report 439, 1999. The vehicle miles travelled are expressed in vehicle/kilometres on roads in Sweden, 1950–1997.

development curve than have the mileages for light vehicles. This could be normal, as the vehicle mileage by light vehicles on the rest of the road network are not measured in the AADT measurements. Because light vehicles are driven largely on the regional road network, changes in the vehicle mileage by light vehicles on the regional road network may affect the development of the total vehicle mileage by light vehicles to a greater extent than they do the vehicle mileage by heavy vehicles.

However, it should be pointed out that the differences in terms of the development of the vehicle mileage according to the Road Traffic Barometer, AADT measurements, and the Mileage Database are small for light vehicles as well.

3 Current estimation model

In the late 1990s, and at the request of the Swedish Institute for Transport and Communications Analysis (SIKA), VTI developed an estimation model for the annual vehicle mileage on Swedish roads for 1950–1997, broken down by vehicle type. The model is based mainly on measurements of traffic on the state owned road network, which were extrapolated to the entire road network using a constant calculated using information on fuel sales and traffic accidents. The breakdown by vehicle type was performed based on the average number of vehicles registered during the year.[7]

VTI enhanced the model in 2007 by adjusting the constant used in extrapolating the vehicle mileage on the state owned road network to the entire road network and using information from the Mileage Database in breaking down the vehicle mileage by vehicle type.[8]

The estimation of the vehicle mileage using the VTI model can be summarised in the following steps:

- The change in the vehicle mileage on the state owned road network derived from the traffic measurements serves as the basis for estimating the total vehicle mileage on Swedish roads.

- The vehicle mileage on the state owned road network is extrapolated to the entire road network using a constant, which was 1.51 during the 1990s but was gradually reduced in the enhanced model to 1.48 for 2003 and subsequent years.

- The breakdown by vehicle type is performed based on the average shares accounted for by the mileages of each vehicle type as calculated using mileage data for 2001–2003 and the shares of the average number of vehicles registered during the reference year accounted for by each vehicle type, which were calculated by taking the mean number of vehicles in use at the start of the year and the number of vehicles in use at the end of the year. The number of vehicles as of 30 June is used in the case of motorcycles.

[7] VTI Report 439, 1999. Vehicle miles travelled expressed in vehicle/kilometres on roads in Sweden, 1950–1997.

[8] VTI Note 20, 2007. VTI model for estimating annual vehicle miles travelled in Sweden.

3.1 Estimating total vehicle mileage on Swedish roads

In comparing total mileages for Swedish vehicles determined in different ways, Figure 3.1 shows that the total vehicle mileage on Swedish roads as estimated using the VTI model are generally consistent with the mileage data. It is logical that the vehicle mileage estimated using the VTI model are higher, as the mileages do not take into account the difference between the mileage driven abroad by Swedish vehicles and the mileage driven in Sweden by foreign vehicles. However, it should be noted that, given all the assumptions of the VTI model, the total difference is not great enough to explain the large gap for 2002–2005. Nor can the values for 2008 be explained unless we assume that foreign vehicles travelled fewer vehicle miles in Sweden than did Swedish vehicles abroad, which is unreasonable according to other sources.

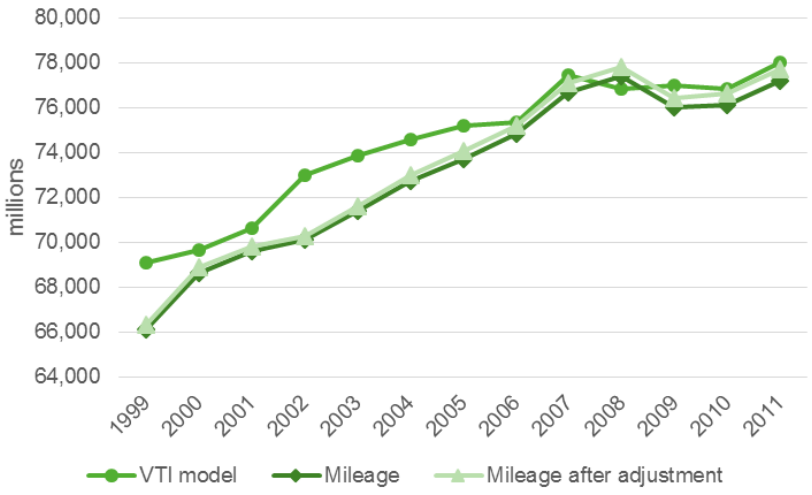


Figure 3.1. Vehicle mileage on Swedish roads (in millions of kilometres) estimated using the current VTI model versus then Mileage Database, mileage for vehicles registered in Sweden and mileage after adjusting for foreign lorries, 1999–2011.

The differences between the adjusted and the VTI model values for estimated total vehicle mileage could be attributable to the following:

- The uncertainty of the Road Traffic Barometer data is so great for some years that it overestimates or underestimates the vehicle mileage compared with the previous year.
- The vehicle mileage on the rest of the road network have not evolved in the same way as have the vehicle mileage on the state owned road network, i.e., the factor used to extrapolate from the state owned road network to the entire road network is not constant.
- The estimated mileages for Swedish vehicles contain an error in the form of a time lag from previous years.

We can rule out the last possibility with reasonable certainty, as some sensitivity analyses and comparisons with other relevant studies indicate that the time lag does not significantly affect the estimated mileages.

Despite these differences, it should also be noted that the model estimates the vehicle mileage relatively well, except for 2002–2005. There is a large difference between the model and the mileage figures for 1999 as well, but this difference may be attributable to inaccurate mileage estimation, as it was the first year when mileages were calculated based on inspection data.

The assumption of constant conditions should be discussed in greater depth. It might be better to use a mean value for adjusted mileages and the development of estimates from the Road Traffic Barometer.

There is also reason to review the level of the extrapolation factor. Comparisons between sources indicate that this factor is overestimated, i.e., that we have underestimated the share of vehicle mileage on the state owned road network.

An extrapolation factor of 1.5 was used during the 1990s. This factor had gradually decreased to 1.48 by 2003, after which it has been used unchanged. In other words, it was assumed in earlier models that the development of the vehicle mileage on the state road network was the same as the development of vehicle mileage on the rest of the road network, an assumption that can be questioned for at least some years.

An extrapolation factor of 1.48 means that the vehicle mileage on the state road network account for 67.1% of the total vehicle mileage in Sweden. This yields a vehicle-miles-travelled figure of 50.49 billion vehicle/kilometres for 2006 if we assume that the adjusted vehicle-miles-travelled figure from the Mileage Database reflects the total vehicle mileage in Sweden. Compared with the vehicle mileage on the state road network obtained from AADT measurements, this gives a 7% underestimation.

However, there are quality deficiencies in the estimated AADT data, because not all the measurements on which the estimates are based were made in the same year and because no projections are made when calculating the vehicle miles travelled.

3.2 Breakdown of vehicle mileage by vehicle type

In this section we will discuss a modified model for estimating vehicle miles travelled, one that differs from the existing VTI model in that the breakdown by vehicle type is based on current annual data in the Mileage Database.

The breakdown of vehicle mileage by vehicle type per the VTI model is based on the change in the breakdown of vehicles in use by type from year to year. This breakdown is calculated by taking the mean of number of vehicles in use at the start of the year and the number of vehicles in use at the end of the year. The

number of vehicles at mid-year is used in the case of motorcycles. To calculate the share of vehicle mileage by each vehicle type, we use the shares of average mileages from 2001 to 2003 accounted for by each vehicle type; these years are assumed to be applicable to other years as well, i.e., we assume that the average annual mileage per vehicle is constant for each vehicle type.

In addition to the latter-mentioned assumption being somewhat unreasonable, the calculated proportional change in the number of vehicles in use is erroneous as well. This is because consideration was not given to the variation in the number of vehicles in use over the months of the year

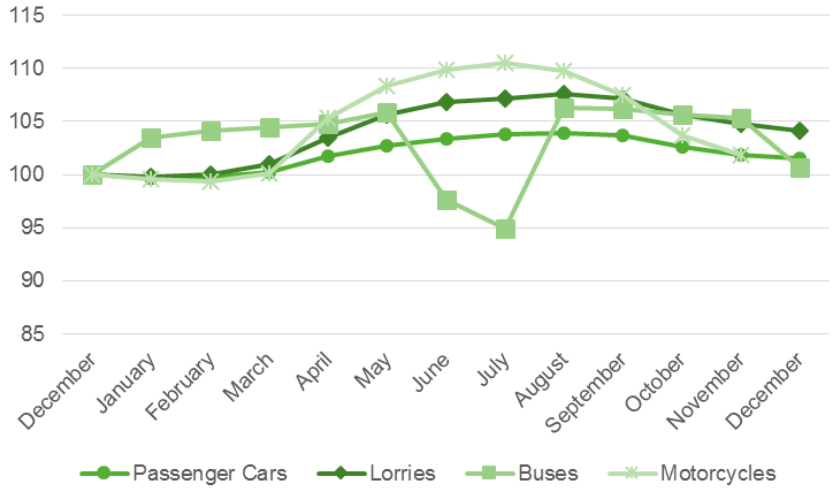


Figure 3.2). The method would have been relevant if the variation followed the same distribution for all vehicle types, but the figure shows that lorries have a higher peak than do passenger cars and that using the number of motorcycles at mid-year leads to overestimation of the share accounted for by motorcycles.

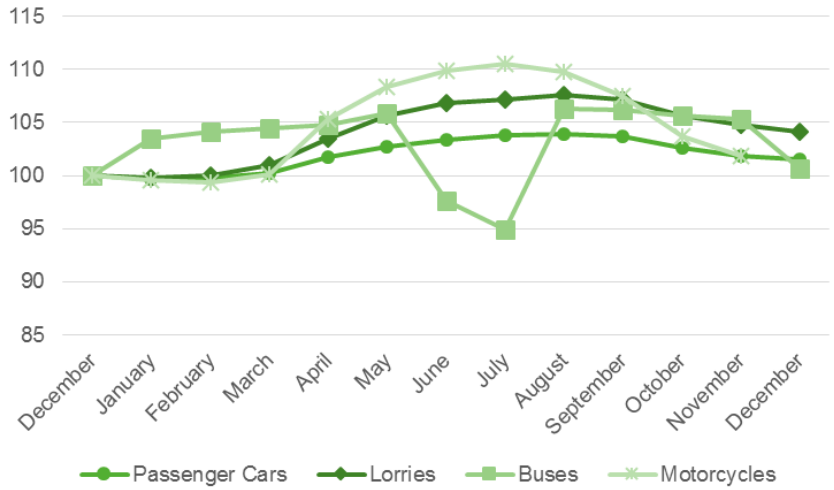


Figure 3.2. Development of number of vehicles in use by month from December 2011 to December 2012 for passenger cars, lorries, buses, and motorcycles. Index, December 2011 = 100. Source: Transport Analysis.

Because Transport Analysis has access to estimated mileage per vehicle, it is better to use the Mileage Database when calculating the shares of the vehicle mileage by the various vehicle types.

Figures 3.3 to 3.7 show the estimated vehicle mileage by motorcycles, light lorries, heavy lorries, buses, and passenger cars according to the existing and modified models, where the mileages are used to calculate the shares of the vehicle mileage by each vehicle type. The estimates of the vehicle mileage are compared with the adjusted mileage for each vehicle type. The comparison shows that the vehicle mileage as estimated using the modified model agree better with the adjusted mileages than do those estimated using the existing model.

The estimated vehicle mileage by motorcycles and light lorries according to the modified model track the adjusted mileages quite precisely. Better estimates are obtained for buses and heavy lorries, albeit with some deviations for 2002–2005. Discrepancies in the estimates still exist with regard to passenger cars, which account for most of the vehicle miles travelled, particularly in 2002–2005.

In summary, it is clear that the modified model, in which the shares of the vehicle mileage accounted for by different vehicle types are calculated based on the Mileage Database, better estimates the vehicle mileage by the various vehicle types on the Swedish road network. However, it should be noted that mileage figures are available only as of 1999, and in deriving estimates for years before that, it is appropriate to apply a minor adjustment to the existing VTI model. Estimates of the vehicle mileage per vehicle type before 2000 can then be adjusted by taking into account the breakdown of the number of vehicles over the entire year, combined with the development of the average annual mileage for each vehicle type over the years.

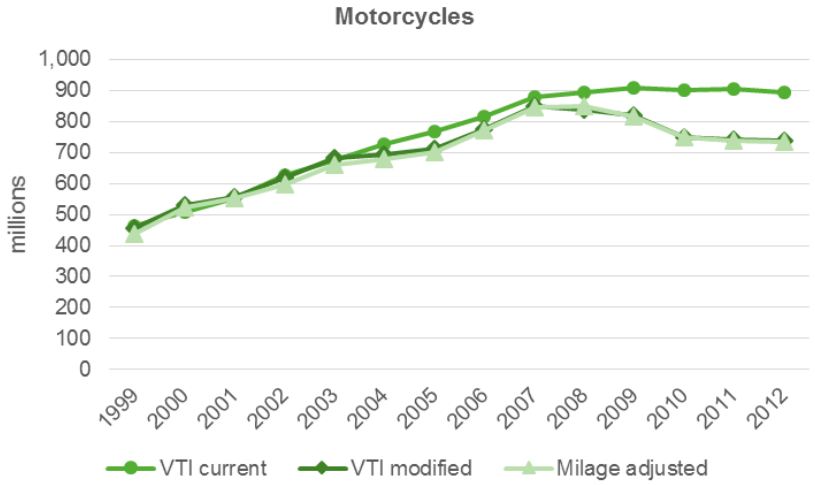


Figure 3.3. Estimated vehicle mileage by motorcycles on Swedish roads (in millions of kilometres) according to current VTI model and modified model versus mileages for motorcycles registered in Sweden, 1999–2011.

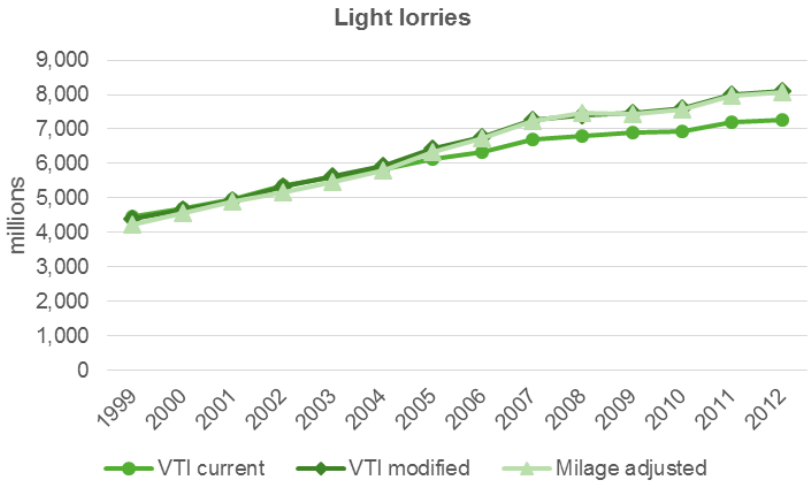


Figure 3.4. Estimated vehicle mileage by light lorries on Swedish roads (in millions of kilometres) according to current VTI model and modified model versus mileage for light lorries registered in Sweden, 1999–2011.

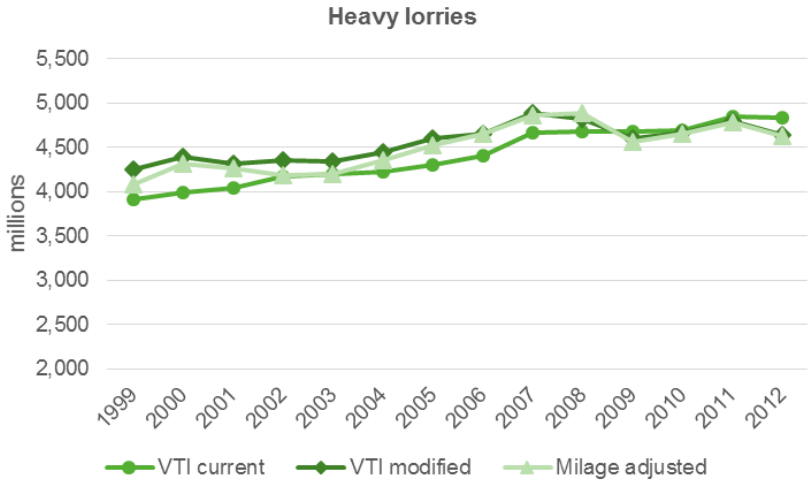


Figure 3.5. Estimated vehicle mileage by heavy lorries on Swedish roads (in millions of kilometres) according to current VTI model and modified model versus adjusted mileage for heavy lorries, 1999–2011.

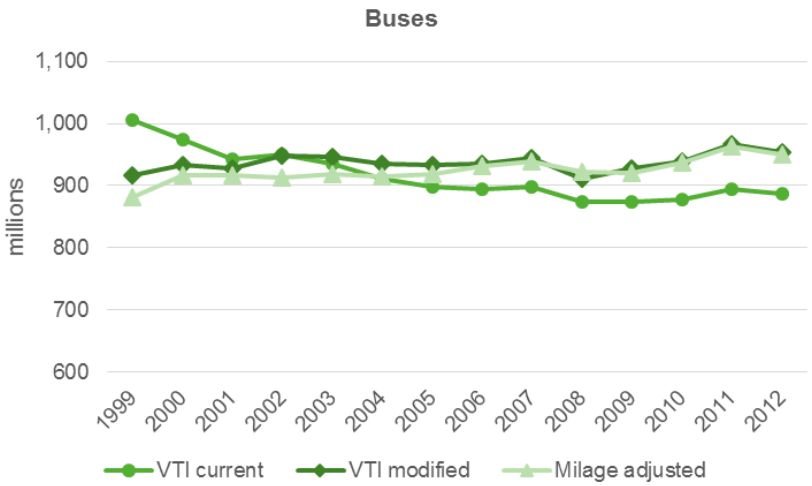


Figure 3.6. Estimated vehicle mileage by buses on Swedish roads (in millions of kilometres) according to current VTI model and modified model versus mileage for buses registered in Sweden, 1999–2011.

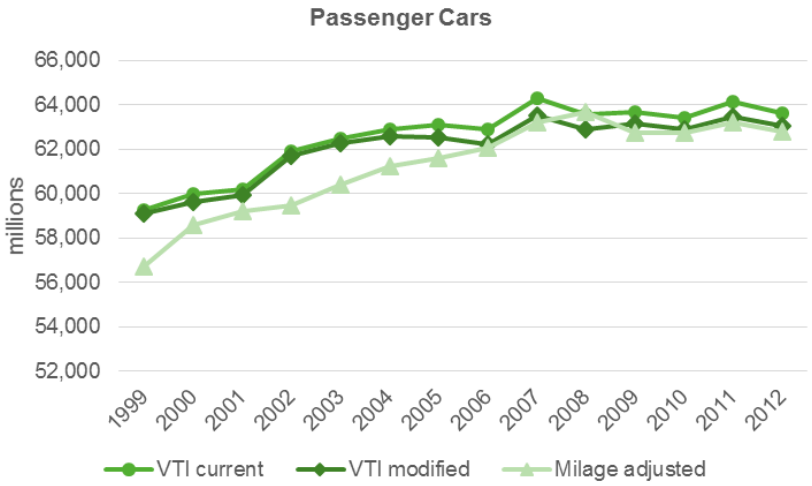


Figure 3.7. Estimated vehicle mileage by passenger cars on Swedish roads (in millions of kilometres) according to current VTI model and modified model versus mileage for passenger cars registered in Sweden, 1999–2011.

4 New model for estimating vehicle mileage in Sweden

As noted earlier, the VTI model, in which data from the Road Traffic Barometer serve as the basis for estimating the total vehicle miles travelled, assumes that the development of the vehicle mileage is the same on the regional road network and on the state owned road network. This assumption should be questioned for certain years.

As long as no traffic measurements are available for the regional road network, it is appropriate to use, as an alternative estimation, results from the Mileage Database in estimating the development of traffic on the regional road network.

Mileages for vehicles registered in Sweden have been calculated starting as of 1999, and with high quality starting as of 2000, based on odometer readings. The mileages include vehicle mileage by vehicles driven on the regional road network, while accounting for a large share of the vehicle mileage as estimated from measurements made on the state owned road network. This makes it appropriate to estimate, as of 2000, the vehicle mileage on Swedish roads as a mean value of the traffic development according to the Road Traffic Barometer and to the mileages. In addition, using the mileages as a source for the estimated vehicle mileage gives us a variable factor for use in extrapolating from the state owned road network to the entire road network. The details of this method are described below.

4.1 Estimating total vehicle mileage on Swedish roads

The total vehicle mileage on the state road network were calculated using the old VTI model through the year 1999 (see Chapter 3).

As of 2000, the mileages for vehicles registered in Sweden have also been used after adjustment using the vehicle mileage by foreign lorries (see Chapter 2.3) as the source for estimating the total vehicle miles travelled. In other words, the vehicle mileage on the Swedish road network in the new model are calculated as the mean of the vehicle mileage according to the VTI model and the mileages for Swedish vehicles after adjusting for the traffic attributable to foreign lorries. The estimated vehicle mileage according to the new model for 1990–2012 are shown in Table 4.1.

Table 4.1. Vehicle mileage (in millions of vehicle/kilometres) according to the new model versus vehicle mileage according to the VTI model and mileage for vehicles registered in Sweden after adjusting for traffic attributable to foreign lorries. Source: Transport Analysis.

Year	Vehicle mileage on Swedish roads according to the VTI model	Mileage for Swedish vehicles adjusted for traffic attributable to foreign lorries	Vehicle mileage on Swedish roads according to the new model
1990	63,887		63,887
1991	64,867		64,867
1992	65,537		65,537
1993	64,136		64,136
1994	64,904		64,904
1995	65,700		65,700
1996	66,029		66,029
1997	66,227		66,227
1998	66,955		66,955
1999	69,098		69,098
2000	69,193	68,878	69,036
2001	70,154	69,828	69,991
2002	71,361	70,286	70,824
2003	72,506	71,604	72,055
2004	73,642	73,004	73,323
2005	74,505	74,044	74,275
2006	75,239	75,168	75,204
2007	77,224	77,069	77,146
2008	77,423	77,814	77,619
2009	76,659	76,439	76,549
2010	76,710	76,627	76,668
2011	77,802	77,677	77,739
2012	77,326	77,196	77,261

4.2 Breakdown of vehicle mileage by vehicle type

As of 2000, the vehicle mileage on the Swedish road network have been broken down by vehicle type based on shares calculated from the mileages, after adjusting for foreign traffic attributable to Swedish lorries and traffic attributable to foreign vehicles in Sweden.

For the years before 2000, for which mileages are lacking, the shares attributable to the different vehicle types are estimated using a model that takes

into account the relationship between the number of vehicles in use throughout the year and the number of vehicles in use at the end of the year, plus the development of the average mileage for each vehicle type.

Table 4.2 shows that the number of vehicles in use at the end of the year correlates well with the number of days in use generated by all vehicles in use at some time during the year. This applies to all vehicle types.

Table 4.2. Number of vehicles in use at the end of the year versus number of days in use generated by all vehicles in use during the year, broken down by motorcycles (MC), passenger cars (PC), buses, light lorries (LL), heavy lorries with a total weight of 3.5–16 tonnes (HL1), heavy lorries with a total weight of 16–26 tonnes (HL2), and heavy lorries with a total weight of over 26 tonnes (HL3), 2000–2004. Source: Transport Analysis.

Year		2000	2001	2002	2003	2004
MC 30/6	Number of vehicles	167,346	182,095	201,522	217,262	235,192
	Days in use, 1000s	31,749	34,946	38,638	42,015	45,949
	ratio	***190***	***192***	***192***	***193***	***195***
PC	Number of vehicles	3,998,614	4,018,533	4,042,792	4,075,414	4,113,424
	Days in use, 1000s	1,473,282	1,514,999	1,506,352	1,514,906	1,531,042
	ratio	***368***	***377***	***373***	***372***	***372***
Buses	Number of vehicles	14,417	14,246	14,013	13,742	13,363
	Days in use, 1000s	5,433	5,430	5,354	5,257	5,199
	ratio	***377***	***381***	***382***	***383***	***389***
LL	Number of vehicles	297,207	318,586	332,777	346,405	364,505
	Days in use, 1000s	108,082	118,402	123,431	128,547	134,968
	ratio	***364***	***372***	***371***	***371***	***370***
HL 1	Number of vehicles	27,727	27,525	26,658	25,895	25,421
	Days in use, 1000s	10,751	10,747	10,621	10,291	10,085
	ratio	***388***	***390***	***398***	***397***	***397***
HL 2	Number of vehicles	32,336	31,087	29,759	28,419	27,807
	Days in use, 1000s	12,518	12,045	11,681	11,201	10,849
	ratio	***387***	***387***	***393***	***394***	***390***
HL 3	Number of vehicles	16,952	18,495	19,746	20,842	22,252
	Days in use, 1000s	5896	6571	7085	7579	8045
	ratio	***348***	***355***	***359***	***364***	***362***

These strong correlations can be used to estimate the number of days in use generated by all vehicles in use at any time during the year by adapting regression lines for each vehicle type, using the number of vehicles in use at the end of the year as an explanatory variable.

The days in use can be estimated using the following regression equations; for motorcycles:
$Days\ in\ use = 207{,}49 * vehicles\ in\ use\ at\ the\ end\ of\ the\ year - 3 * 10^6$

For passenger cars:
$Days\ in\ use = 384{,}72 * vehicles\ in\ use\ at\ the\ end\ of\ the\ year - 5 * 10^7$

For buses:
$Days\ in\ use = 245{,}55 * vehicles\ in\ use\ at\ the\ end\ of\ the\ year + 1{,}9 * 10^6$

For light lorries:
$Days\ in\ use = 395{,}39 * vehicles\ in\ use\ at\ the\ end\ of\ the\ year - 9 * 10^6$

For heavy lorries, which are divided into three classes based on total weight, i.e., 3.5–16 tonnes, 16–26 tonnes, and >26 tonnes, the following regression equations are used for each class, respectively:
$Days\ in\ use = 288{,}32 * vehicles\ in\ use\ at\ the\ end\ of\ the\ year + 3 * 10^6$
$Days\ in\ usei = 353{,}12 * vehicles\ in\ use\ at\ the\ end\ of\ the\ year + 10^6$
$Days\ in\ use = 409{,}85 * vehicles\ in\ use\ at\ the\ end\ of\ the\ year - 10^6$

To calculate the shares of mileage attributable to each vehicle type, it is also necessary to estimate the average daily mileage for vehicles of each type. Because 1990s mileage information for Swedish vehicles is lacking, we should be able to estimate the average daily mileage based on estimates for 2000–2004 by extrapolating a regression line back to 1990. However, this is not entirely suitable, as we lack information characterising the trends of the 1990s.

A more conservative approach is instead to use the mean daily mileage for each vehicle type between 2000 and 2002. This mean value is then assumed to correspond to the average daily mileage for these vehicle types throughout the 1990s (Table 4.3).

Table 4.3. Development of average daily mileage per vehicle by vehicle type, in kilometres, 2000–2004. Source: Transport Analysis.

Year	MC	Passenger cars	Buses	Light lorries	Heavy lorries 1	Heavy lorries 2	Heavy lorries 3
2000	16.44	39.74	168.78	42.32	53.77	160.97	252.11
2001	15.76	39.09	168.80	41.23	51.92	155.07	246.28
2002	15.42	39.46	170.53	41.70	50.36	151.27	240.33
2003	15.72	39.85	174.64	42.41	50.38	150.21	240.16
2004	14.79	40.01	176.09	43.00	50.49	149.36	240.22
Mean, 2000–2002	**15.87**	**39.43**	**169.37**	**41.75**	**52.02**	**155.77**	**246.24**

The average daily mileage for each vehicle type multiplied by the estimated number of days in use for each vehicle type yields an estimated annual mileage

for vehicles registered in Sweden for each vehicle type. In addition, estimated mileages have been used to calculate the mileage shares for each vehicle type presented in Table 4.4 for 1990–1999.

Table 4.4. Estimated shares of vehicle mileage by vehicle type according to the new estimation model, 1990–1999. Source: Transport Analysis.

Year	MC	Passenger cars	Buses	Light lorries	Heavy lorries 1	Heavy lorries 2	Heavy lorries 3
1990	0.0047	0.8693	0.0153	0.0562	0.0108	0.0387	0.0049
1991	0.0048	0.8712	0.0153	0.0576	0.0105	0.0349	0.0058
1992	0.0052	0.8711	0.0152	0.0576	0.0102	0.0338	0.0069
1993	0.0055	0.8703	0.0152	0.0572	0.0100	0.0339	0.0079
1994	0.0055	0.8694	0.0152	0.0568	0.0099	0.0339	0.0093
1995	0.0055	0.8682	0.0152	0.0572	0.0097	0.0333	0.0109
1996	0.0057	0.8672	0.0152	0.0582	0.0095	0.0317	0.0125
1997	0.0061	0.8646	0.0150	0.0596	0.0092	0.0311	0.0144
1998	0.0063	0.8614	0.0146	0.0617	0.0088	0.0309	0.0163
1999	0.0067	0.8585	0.0141	0.0635	0.0086	0.0295	0.0191

Finally, the vehicle mileage on the Swedish road network broken down by vehicle type are calculated by multiplying the share for each vehicle type by the estimated total vehicle mileage on Swedish roads as calculated using the model. The results of the breakdown of vehicle mileage by vehicle type are presented in

Table 4.5.

Table 4.5. Vehicle mileage on the Swedish road network estimated using the new model, in millions of vehicle/kilometres; total and broken down by vehicle type, 1990–2012. Source: Transport Analysis.

Year	MC	Passenger cars	Buses	Light lorries	Heavy lorries 1	Heavy lorries 2	Heavy lorries 3	Total for all vehicles
1990	300	55,756	984	3605	695	2635	335	64 310
1991	309	56,373	987	3727	678	2395	397	64,867
1992	340	56,948	993	3764	665	2346	481	65,537
1993	350	55,674	971	3659	641	2303	538	64,136
1994	355	56,282	981	3678	642	2326	641	64,904
1995	363	56,890	994	3747	634	2318	754	65,700
1996	378	57,109	999	3831	623	2217	872	66,029
1997	401	57,104	990	3938	605	2182	1007	66,227
1998	419	57,508	976	4120	588	2186	1158	66,955
1999	463	59,142	975	4375	592	2158	1393	69,098
2000	527	59,089	925	4616	583	2168	1599	69,506
2001	554	59,560	922	4910	561	1997	1730	70,235
2002	607	60,576	931	5246	545	1897	1828	71,630
2003	671	61,322	933	5537	527	1798	1945	72,732
2004	687	61,920	926	5867	515	1773	2114	73,801
2005	707	62,059	925	6365	499	1749	2316	74,620
2006	772	62,148	933	6750	494	1683	2477	75,257
2007	848	63,355	942	7238	488	1638	2753	77,262
2008	842	63,277	917	7435	462	1497	2896	77,325
2009	817	62,946	924	7448	427	1299	2853	76,714

2010	749	62,798	937	7588	409	1258	2992	76,731
2011	740	63,353	964	7986	400	1224	3165	77,833
2012	736	62,940	951	8098	377	1094	3160	77,356

5 Conclusions

The estimation of vehicle mileage using the VTI model is based on the development of vehicle mileage on the state owned road network obtained from traffic measurements.

One weakness of the model is the assumption of a constant relationship between the development of the vehicle mileage on the state owned road network and on the rest of the road network, an assumption that should be questioned for certain years.

The subsequent breakdown of the vehicle mileage by vehicle type according to the VTI model is based on the breakdown of the number of vehicles in use and its development from year to year. This method has its deficiencies, insofar as it overlooks the variation in the number of vehicles in use from year to year and from month to month.

Comparison of Mileage Database data and traffic measurements on the state owned road network has indicated that, independent of one another, these sources present two largely similar pictures of the total vehicle miles travelled. However, both these sources have limitations that make it difficult to use either one as the sole source for estimating the actual vehicle mileage in Sweden.

The mileages for Swedish vehicles are available as of 1999. These data can be improved by adjusting for traffic attributable to foreign lorries in Sweden. This information can be obtained from the road freight survey for heavy lorries registered in Sweden, and from corresponding road freight surveys in other EU countries.

The vehicle mileage on the rest of the road network that are attributable to vehicles registered in Sweden are represented in the Mileage Database. These vehicle mileage simultaneously account for a large share of the vehicle mileage that cannot be estimated based on measurements made on the owned road network. This makes it appropriate, as of 2000, to estimate the vehicle mileage on Swedish roads as a mean value of their development per the Road Traffic Barometer and the development of the mileage data. This means that the new model takes into account the difference between the development of the vehicle mileage on the state owned road network and the development of the vehicle mileage on the rest of the road network.

Furthermore, the breakdown of vehicle mileage by vehicle type should also be performed by calculating the shares of the vehicle mileage by each vehicle type based on the mileages in the mileage database and not, as previously, based on the proportions of vehicles. For those years for which mileage data are lacking, the shares for the various vehicle types are estimated using a model that takes into account the relationship between the number of vehicles in use throughout

the year and the number of vehicles in use at the end of the year, plus the development of the average mileage for each vehicle type.

One remaining limitation of the new estimation model is that there is a certain time lag in the estimates because the mileage data are collected from vehicle inspections, which occur with a periodicity that differs from the calendar year.

As noted earlier in the report, it is desirable to present the data regarding vehicle mileage on the Swedish road network as soon as possible after the end of the year in question. However, the data regarding vehicle mileage by motorcycles based on the Mileage Database do not become available until the fall of the following year. The same is true for vehicle mileage by foreign lorries based on the European road freight surveys. This means that it should be possible to present preliminary data in the spring, making preliminary estimates of the vehicle mileage by motorcycles and by foreign lorries, and then adjusting those data to produce official results in the fall.

Transport analysis

Transport Analysis is a Swedish agency for transport policy analysis. We analyse and evaluate proposed and implemented measures within the sphere of transport policy. We are also responsible for official statistics in the transport and communication sectors. Transport Analysis was established in April 2010 with its head office in Stockholm and a branch office in Östersund.

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